Vol. 2. July—September, 1921. [No. 4.

AGRICULTURAL CIRCULAR

ISSUED BY THE

DEPARTMENT OF AGRICULTURE
FIJI

EDITED BY

THE SUPERINTENDENT OF AGRICULTURE

Annual Subscription, 3/-

Price One Shilling.

By Authority: S. Bach, Government Printer, Suva.
1921.

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DEPARTMENTAL NOTES.

A letter received from the Canadian Department of Agriculture advises that importation of fruits from Fiji will be permitted provided this Department certifies that they are free from disease. Boxes, crates, or other containers should be marked with the name and address of the consignor and consignee respectively. Certificates of fumigation must accompany consignments.

Regulations governing the export of bananas have been amended. Regulation 10 now directs as follows:—Regulation 10 of 9th March, 1915, is hereby repealed and replaced as follows:—An Inspector may reject the whole or any portion of fruit in any punt or vessel which in his opinion contains an undue proportion of fruit unfit for shipment and the Superintendent of Agriculture or the Chief Inspector of Produce may in their discretion refuse to the exporter of such fruit permission to repack.

With reference to a recent discussion on the use of lime in banana culture it should be noted that it is very desirable to correct the acidity which is present in the soil and especially so in those localities with a heavy rainfall. This acidity of the soil is favourable to the production of fungoid disease in plants. The application of lime not only assists in preventing fungoid diseases, but it is of value as an aid in curing those which already exist. It also makes available for use certain plant foods which are in the soil. As the result of inquiry as to the local method of applying lime to banana plantations, I have learned that it has been the practice to put it in the holes in which the suckers were planted. This was erroneous as even where the rainfall is light lime should be distributed only on the surface and allowed to work downwards as it will do. When placed underground it would, aided by our heavy rainfall, descend beyond the stratum of soil occupied by the banana roots which feed in a limited area near the surface. It should therefore be applied to the surface of finely pulverised soil within the limited radius of the roots of the plants already occupying the soil or the possible extension of those being planted.

Systematic attempts have been made to trap the Banana borer (*Cosmopolites sordida*) in the old established plots of bananas at Nasinu. This trapping has now been in progress for nine weeks during which 6,906 (six thousand nine hundred and six) beetles have been captured and destroyed or an average of 734 per week. The effect of this continuous trapping cannot fail to have marked effect upon the young suckers as they come up, many of which were formerly riddled and sometimes absolutely hollow.

SENSITIVE PLANT (*Mimosa Pudica.*)

By G. M. McKeown.

I have had this plant under careful observation since my arrival and as a result I have come to the conclusion that its value as a pasture plant has been greatly over-rated. It possesses several disadvantages which far outweigh its good points. These are its objectionable thorns and the fact that a very small portion of the plant is eaten by stock, which carefully nip off the tips of the branches which contain young growth comprising leaves, flowers, and seed pods. This portion comprises probably not more than one-sixth of the plant product, the remainder being left to encumber the land with material which stock will not eat except under the compulsion of extreme hunger.

On the numerous occasions on which cattle have been watched while feeding on pastures in which sensitive plant was plentiful very few were seen to eat it if grass could be had. The cattle were frequently noticed tossing the plants aside where it was possible, so as to get at the grass growing through the outer edges of the clumps of sensitive plant. This was the case even when cattle were tethered on such pasture. On the few occasions on which cattle were seen to eat it they carefully nipped off the points of the branches with the tips of their tongues.

As the plant belongs to the leguminous order which comprises many plants of high value such as lucerne, clover, &c., it was quite understood that an analysis of the plant would disclose a satisfactory protein content. In samples comprising tips with flowers and leaves, the flesh-forming elements were present in satisfactory quantity but it proved weak in carbohydrates or fat formers.

A second analysis was made of entire plants the result of which is far less favourable than that of the tips as there is a loss of flesh forming ingredients, and a marked increase in fibre which indicate a depreciation in value.

In Ceylon and Papua the sensitive plant is proclaimed a noxious weed and its destruction is compulsory. In a number of tropical countries although its qualities as a soil renovator are recognised its use in coconut or rubber plantations is condemned on account of its objectionable features.

There is ample evidence in districts that I have visited, that a satisfactory crop of grass cannot be obtained where the sensitive plant is allowed to run its course. The Queensland Government Botanist, Mr. F. M. Bailey, F.L.S., reports: "This tropical American plant has became a pest in many parts of the State particularly in grass lands." In Ceylon it is classed as one of the five worst weeds in crops, and Mr. McMillan, Superintendent of the Royal Botanic Gardens, describes it as "a pestiferous weed" in that country.

Analyses by C. H. Wright, M.A., F.I.C., Government Chemist.

Sample No. 54.—This sample was obtained by me from a patch of sensitive plant which was in flower; and consisted of the ends of the young stems

with leaves and flowers, such as cattle would eat. On arrival at the laboratory the sample contained 74·94 per cent. of water. The remainder of the sample was cut up and dried at air temperature. The air-dried material was then finely ground up, and analysed with the following results:—

Water	13·26
Protein	19·06
Oil	2·83
Carbohydrates	30·83
Fibre	28·43
Ash	5·59
	100·00

From the above results the composition of the fresh material can be calculated. It is as follows:—

Water	74·9
Protein	5·5
Oil	·8
Carbohydrates	9·0
Fibre	8·2
Ash	1·6
	100·0

The above sensitive plant contains far more protein and less carbohydrates than most grasses. In composition it is very similar to other green legumes, such as clover and alfalfa.

Sample No. 85.—This sample was obtained by me from a patch of sensitive plant, which had not been eaten by cattle, and consisted of the whole plant above ground, including the flowers and fruits. On arrival at the laboratory the sample contained 65·73 per cent. of water. The remainder of the sample was cut up and dried at air temperature. The air-dried material was then finely ground up, and analysed with the following results:—

Water	12·20
Protein	9·69
Oil	1·65
Carbohydrates	35·64
Fibre	36·81
Ash	4·01
	100·00

From the above results the composition of the fresh material can be calculated. It is as follows:—

Water	65·7
Protein	3·8
Oil	0·6
Carbohydrates	13·9
Fibre	14·4
Ash	1·6
	100·0

The above analysis shows that the whole plant contains less water and protein and slightly less oil, but more carbohydrates and fibre, than the young stems (see report on sample No. 54).

BANANA PLANT FIBRE.

The commercial possibilities of banana plant fibre has engaged the attention of planters and others interested from time to time, and some Tweed River growers have had under consideration the formation of a syndicate to thoroughly explore those possibilities.

A number of banana fibre products have been submitted to our inspection, and as samples they appeared to be all that could be desired. A textile product woven from processed fibre had a fine silky appearance, and its value as a possible substitute for panama hat material was suggested. Another possibility is the production of vegetable silk from the residue of the treated material after the fibre has been extracted.

The question of the value of fibre from the stem of the banana is a recurring one, and should be approached with all due caution. In the West Indies many years ago, Sir D. Morris, D.Sc., D.C.L., F.L.S., Director of Public Gardens and Plantations, Jamaica, devoted close attention to it. One of his successors, William Fawcett, B.Sc., F.L.S., in his work *The Banana: Its Cultivation, Distribution, and Commercial Uses* (1913), p. 151, says:—

"The stem (banana) yields less than 1½ per cent. of its weight; that is about 1½ lb per ordinary stem as cut. To obtain 1 ton of fibre it would therefore be necessary to handle nearly 100 tons of fresh stems, which must be dealt with as soon as cut, on the spot. It is considered that the value, as manure, of the chopped stems is perhaps two or three times the value of the fibre. No reasonable person would wish to export fibre to the detriment of his land. The banana and plantain are grown primarily for the fruit, and not for fibre.

"In 1905 when the subject was under discussion, Sir D. Morris sent the following communication to the Jamaica Agricultural Society.

"I enclose a summary of the facts obtained as the result of experiments during the last twenty years. They are as follows:—A banana stem just after fruiting if cut, as usual with the country people, about 2 ft. above ground, and denuded of its foliage, weighed 108 lb; this being divided into three lengths of 2½ ft. each split longitudinally into several pieces was prepared by beating and washing by hand, and yielded 25 oz. of clean marketable fibre, which is at the rate of 1·44 per cent. of the gross weight. The fibre of the lower portion of the stem as also the fibre in the petioles of the leaves was not extracted.

"A smaller banana cut under similar circumstances weighed 41 lb. This was divided into two lengths of 2½ ft. each and after being split longitudinally into several pieces was prepared by hand and yielded 6¾ oz. of clean fibre, or at the rate of 1·02 per cent. on the gross weight.

"At the Hope Plantations similar experiments were conducted with banana stems, which yielded very much the same results. Two banana stems, cut after fruiting at 2 ft. from the ground and denuded of their leaves, weighed 147 lb. These yielded 33 oz. of clean fibre, or at the rate of 1·44 per cent. on the gross weight.

"From ordinary stems of bananas, cut after fruiting at about 1½ to 2ft. above ground, a settler might prepare about 1½ lb of clean fibre, but if the stems are large and the whole of the length is used as well as the petioles of the leaves the amount of the fibre might be increased to 2½ lb if not 3 lb per stem.

"It must be borne in mind that to obtain 1 ton of banana fibre it will be necessary to handle nearly 100 tons of fresh stems. These cannot be carried to a central place for treatment, as the cost of the fibre would be increased beyond its market value. The stems will be required to be dealt with on the spot.—*Queensland Agricultural Gazette.*

APPLIED ENTOMOLOGY.

In earlier days entomology was looked upon as a pastime for the spare moments of those who cared to turn their attention to it, or as a business confined to dusty museums without any practical application whatever; the true significance of the study was not then apparent. Gradually the practical side developed and has since continued to develop until at the present time economic entomology is recognised by agriculturists as an important adjunct to the study of the actual crop production, without some knowledge of which the cultivator of plants is likely to meet with obstacles before his harvest is over or his products in the hands of the consumer.—*Philippine Agricultural Review.*

LIME AS A FACTOR IN SOIL IMPROVEMENT.

The following article by Mr. R. S. Cunliffe, B.Sc., is of interest. It may be mentioned that recent work has shown that some of the so-called lime-loving plants thrive best on limestone soils, not because of the presence of lime itself, but because the water conditions are such as to render these soils unattractive to plants in general:—

As the use of lime as a factor in the improvement of soil conditions in the West Indies has been deemed in the past by planters to be of considerable importance, it may be of interest to draw attention to a few of the problems connected with liming, and the present status of knowledge, derived from experimental data and otherwise, on the subject.

The value of lime in agriculture generally has been demonstrated by practical experience for a very long time in many countries, and under different soil and crop conditions, and the scientific questions involved in its correct and economical use are revealed to be of such a complicated and far-reaching character that further investigation of the subject, especially in the tropics, is a matter of major importance in crop production and soil improvement, and particularly so in those colonies where liming has become a well-established practice in recent years, apparently with beneficial results, but without much thought or idea as to what ultimate conditions may arise from the—in some instances at least—free use of lime materials.

The underlying scientific reasons for the need of lime, and the functions performed by it in the plant, are still matters of wide difference of opinion among investigators. This discussion ranges over the questions: Is there free acidity in the soil? What is the relation of free acid to lime or other base? What tests, if any, constitute an adequate measure of the need for lime by a particular soil type? Is free acidity itself the limiting factor, or is it correlated with some other condition? Whatever may be the answer to such questions, the opinion is quite generally held among investigators, that the need for lime is associated in some way, directly or indirectly, with an acid condition of the soil as measured by the absorption of a base.

As regards the range of tolerance by different crops of an acid or alkaline condition of the soil, very little is definitely known, but a wide variation is shown by the behaviour of certain plants under acid, neutral, or alkaline conditions. Some plants have a wide range of tolerance, others not so; and apparently this applies not only to the higher plants, but also to micro-organic life species, whether of a normally beneficial or detrimental character; an aspect of the matter nevertheless of great practical importance. Certain it is that plants cannot be divided sharply into two classes, one of which will thrive under acid soil conditions, the other under an alkaline reaction. Rather does the available data show every gradation of tolerance among

plants: and herein arises another point. Too often it is assumed, that for plants which thrive on a soil close to the neutral point, too much carbonate of lime cannot be added to the soil. As has been shown by some field results, however, the question might very properly be asked, whether the alkaline tolerance of plants may not be quite as important to determine as their tolerance of acid conditions in the soil.

Coming to the application of lime materials, including both the caustic and the carbonate forms, two classes of problems present themselves, viz.: (1) What are the effects of equal or equivalent amounts of these two forms of lime? (2) What are the relative practical aspects of the use of these different materials? Closely connected with such questions, we have those of the relation of lime to the availability of phosphorus and potash, and the ultimate relation to the store of nitrogen in the soil, as well as other bio-chemical factors of less direct practical interest. Our knowledge on such points, however, is far from reaching definite conclusions.

Much information of a more or less indefinite and misleading character has been disseminated with regard to the relation of different forms of lime to soil organic matter, little or no distinction having been drawn between purely chemical reactions and those of a biological nature. The idea commonly held that caustic lime is especially destructive of organic matter, has usually been conceived as a more or less purely chemical process, which theory has been generally extended to inhydrated lime, because of its caustic properties. Unquestionably chemical reaction takes place, but that this is truly destructive of valuable humus, has not been demonstrated. The chemical and biological relations of the problem are of considerable practical value, as on the satisfactory solution of such, rests the answer to the question as to whether caustic forms of lime, in suitable amounts, may or may not be better than carbonate forms. What, for instance, are the effects of caustic and carbonate forms of lime on the granulation and porosity, and related problems of different soils. Are these effects the issue, or do they differ with different kinds of soil Available data indicate that the caustic forms are the more active in this respect, while the carbonate are either nearly inactive, or produce in some soils an unfavourable reaction. Does such data as exist on this point furnish the ultimate reply to such questions?

Closely connected with the above is the question as to how long caustic lime remains as such in the soil. Recent experimental work indicates that the period of recarbonisation is very short. Some investigators also indicate that certain silicate forms of lime are capable of exercising almost the same functions as carbonate, which is of interest as regards the use of such forms as basic slag. This matter of the value of silicate forms and similar combinations is again closely connected with the question of fineness of lime materials applied to the soil. If lime in such forms of combinations, is just as effective as the carbonate form, it would then seem permissible to apply those forms of lime which most readily form such combinations, namely, burnt lime, and very finely ground carbonate. Again, such silicate forms suggest the precipitation of colloidal silicates, a milder alkalinity, and a conservation of lime materials in the soil without interfering with their usefulness.

Connected with the question of fineness of division is that of the movement of lime through the soil, and the possibility of loss from leaching. The analysis of the soil of one of the fields at Rothamsted shows over 3 per cent. of carbonate of lime in the first 9 inches, but none in the second, a result that appears to be due to the application of chalk to the land so long ago that the record is lost. This would indicate, in this instance at least how slow is the movement of lime materials.

Again, as regards the question of degree of fineness to which limestone should be ground, so as to perform the full functions of such material within the period for which it is applied, the practical data are very meagre. How coarse may such material be applied without sacrificing its efficiency? Observations on some calcareous soils reveal a reaction distinctly acid to litmus, notwithstanding the presence in such soils of particles of carbonate of lime. The question of suitable fineness cannot be regarded as settled in any sense, and to advise the use of a sufficient amount of coarsely ground material, on the chance that there may be enough finely ground substance to supply the needs of the soil, runs into economic questions, and that of how far the time element may compensate for lack of fineness.

It will be observed from these few notes that the question of caustic *versus* carbonate of lime, fine *versus* coarse materials, calcium *versus* magnesium, and the amounts necessary for particular crops under varying conditions of soil and climate, as well as other problems directly or indirectly connected with liming, have at least been imperfectly investigated. Practical work in this respect is largely as yet on an empirical basis, and until more accurate scientific data are available, it would seem prudent to proceed with caution in the indiscriminate use of lime materials.—*Agricultural News.*

THE ALGAROBA TREE.

From a Hawaiian source we take the following interesting article on this valuable tree, entitled "The Algaroba Tree":—

Although the algaroba, or keawe, is not a native of Hawaii—it was introduced to the islands by Father Bachelot, a French missioner, in 1828—the Hawaiian territory can claim the credit of having discovered the many extraordinary merits of this remarkable tree and of having turned its cultivation for the first time in history to the uses of man. No one knows precisely from what country the algaroba originally came. Little more, indeed, is known of its early history than that a fine ornamental specimen flourished in the Jardin du Roi de Paris in the first quarter of the nineteenth century; and it was from this very tree that Father Bachelot brought the seed which he planted beside the Catholic Cathedral at Honolulu in 1828. Of all the seeds the French missioner planted only one germinated. It rapidly developed into a fine tree, and within a few years it overtopped the cathedral, and covered all the mission buildings with its grateful shade.

For some decades not a living soul suspected the great part this tree was destined to play in the industrial development of the Hawaiian Islands; and no attempt was made to investigate its habits or to solve the mystery of its rapid spread until algaroba forests actually threatened to displace the indigenous island growths. It was then noted by a local botanist that cattle had been the active instruments of this astonishing phenomenon. Admitted to the mission grounds, they had eaten the beans lying under the famous cathedral tree and carried the seeds up to the barren hillsides of extinct craters, to be deposited in crevasses and on elevated coral beds. In these places the seeds, dropped by the mission cattle, had established thick groves of algaroba, covering the once bare lava hillsides with a thick mantle of evergreen, to act as fresh centres of wider distribution through the agency of new generations of livestock.

Carrying his researches a little further, the botanist discovered that the seed of the algaroba is surrounded with a hard casing like that of a shark's egg, which prevents the seed from being digested by cattle feeding on the bean, and thus ensures its chance of germination when rejected in the cattle

excrement in some favouring locality. The first mystery having been solved, later investigators undertook the task of determining the reason of the emphatic predilection exhibited by all sorts of livestock for the bean. The pod was subjected to chemical analysis and the secret was forthwith laid bare. It was found that the bean contains a lot of sugar and a rich proportion of protein, thus rendering it not merely a palatable, but a highly valuable, fodder for all kinds of farm stock. When this discovery was made known the cultivation of the algaroba was no longer left to the unaided and unconscious efforts of the Hawaiian cattle.

Many settlers were prompt to plant algaroba forests on their ranches and holdings, and the success they met with started a movement which has ever since proceeded uninterrupedly, until at the present time the Hawaiian Islands afford the spectacle of an almost uniform forest covering. The supreme peculiarity of the algaroba is that it is essentially a desert growth. It flourishes best where the soil is poor, the elevation fairly low, and where the rainfall is scanty. These conditions very frequently prevail in the Hawaiian Islands—hence the remarkable spread and cultivation of this singular tree, which in the course of a generation has converted most of the bleakest Hawaiian deserts into the most valuable land in the territory. The algaroba, however, would never have attained to its full use as a friend of man without the further aid of science.

The collection and storage of algaroba beans for cattle food had long been an industry of respectable dimensions, when one day (only a few years ago) it occurred to a local chemist to discover if any food values resided in the seed which cattle ate with the pod, but did not digest, for the reasons already stated. The result of his experiments was a convincing demonstration that the seeds hold far more protein than the pod itself. Inventors at once set to work to construct a macerator that would break the seed within the pod, and it was the good fortune of Mr. C. W. Rennear, of Honolulu, to outstrip his competitors and to produce the ideally requisite machine. The effect of this invention was to revolutionise old methods and to turn a comparatively limited activity into a great national industry.

To cite a single apposite illustration there is the case of Molokai. On this island there is a grove of algaroba trees covering 8,300 acres. Before the algaroba was planted there the land was utterly valueless—a piece of bare and uninhabitable desert. The algaroba grove enabled it to support a thriving herd of cattle. The invention of the Rennear machine caused the cattle to be dispensed with and the former desert to become one of the most valuable bits of land in the world. These 8,300 acres produce annually 166,000 tons of beans, which are gathered at a cost of £1 per ton, and have a net sale value after maceration of almost £4 per ton, showing a bulk profit of approximately £600,000 a year.

The Hawaiian Islands are already exporting large quantities of macerated algaroba beans to North and South America and Asia; some is coming to Australia; and they were beginning also to develop markets in Europe when the war broke out. The value of the algaroba as a fodder tree may be defined in a few words. It bears abundantly within two or three years from the seed, and it can produce a net revenue of £80 an acre from land that is totally and absolutely unfit for any other sort of crop.

But the algaroba is not only useful as a fodder tree. The Americans do not call it the "most valuable tree in the world" merely because of its fodder uses, but because there is no other tree known to science which is useful for a greater variety of applied human purposes. The flowers of the

algaroba tree furnish the most important source of pure honey known in Hawaii—famous throughout the world as "the Islands of Flowers."

The production of honey is a great and growing industry in the territory. It all comes from the algaroba tree, which flowers twice a year and produces two crops of beans annually. Formerly the bee raisers of Hawaii got their bee-ranging rights over the algaroba groves for nothing, but they now have to pay heavily for the exclusive privilege of placing their apiaries in the various forest groves—thus giving the algaroba planter a brand new source of revenue.

Algaroba wood constitutes, also, the chief source of fuel in the territory. Its growth is so rapid that planters find it highly profitable to thin out all the larger trees at least once a year for sale as fuel, thus continuously making space for the growth of new generations of trees. The wood burns slowly with a strong and steady glow, and it has a calorific value so high that it can be used in factory furnaces in place of coal or coke. The smaller branches make an excellent charcoal.

As the algaroba is a legume and has a remarkable soil-penetrating power, it is a soil maker of first rate importance.

The bark of the algaroba contains a large proportion of tannin, and is finding a large use in the leather industry.

The gum of the algaroba provides a profitable use in the manufacture of varnish.

The pods of the algaroba are largely and increasingly used in the manufacture of vinegar and denatured alcohol because of their high sugar content.

The boles of the algaroba tree make excellent piles for use in all coastal waters, both by reason of their toughness and durability and because they are practically immune from the attack of the toredo worm.

Finally, the algaroba has a high artistic value as an ornamental growth and as a shade tree, for its form is extremely graceful and spreading, and its foliage is both delicate and beautiful.—*Queensland Agricultural Journal.*

PREVENTION OF DISEASE AMONGST POULTRY.

All diseases of stock are preventable, and none more easily than those of poultry. To the lay mind this may seem a rash assertion, writes Mr. A. Little, Poultry Expert, in an interesting article appearing in a recent number of the *Rhodesia Agricultural Journal* (Vol. XVIII, No. 1), and perhaps especially so to the ordinary poultry keeper, he adds, who as a rule seems to think that fowls are naturally subject to disease, and quite expects them to be so. Nothing could be more erroneous. The health or otherwise of poultry, Mr. Little rightly states, depends not upon themselves, but upon those who are supposed to be looking after them.

Disease, he points out, is almost invariably caused by lack of attention and proper knowledge of measures necessary to keep poultry in good health, as well as from ignorance on the part of the owners, of the requirements of their birds. Again, health or disease is transmitted from one generation to another, and this again is the fault of the owner. It is possible practically to stamp out disease, and in fowls, where we *can* have two generations a year, it is more easy of accomplishment than in most stock. The fowl whose vitality is lowered is much more susceptible to any disease inherent in it, or to infection by any disease in its vicinity, than one whose vitality is at the highest pitch. The case of a bird whose parents or grandparents have suffered from tuberculosis, is instanced. Such a bird had in its system the tubercular bacilli, and these, as long as the bird is kept in good health,

are latent, and are kept in check by the phagocytes, which are the health-giving microbes present in all animals and human beings; but if the vitality of this bird is allowed to become below par by reason of wrong treatment, in feeding, &c., or by dirty surroundings, or by housing in stuffy, draughty or in any way unhygienic houses, the phagocytes are weakened, and the disease germ (in this instance the tubercle bacillus) immediately overpowers them. The fowl then becomes ill, and if it is an infectious or contagious disease, the bird in its vicinity, which may not necessarily have this particular disease germ latent in its system, but whose vitality may be lowered, immediately contracts the disease, which rapidly spreads. Each bird which is affected and cured has in it the seeds of the disease, and will transmit it to all its progeny. This is the reason why we have disease among fowls to such an extent. How often do we find the vitality of fowls lowered by dirty food, indigestible food, food of too starchy and fattening a nature (the over-fatty condition of a fowl is one of the most common reasons for lowered vitality and disease), too little exercise, dirty water, and often no water at all for hours together and on hot blazing days, lack of grit and charcoal, dirty houses, dirty runs, unventilated, stuffy or draughty and damp houses, birds soaked through with the rain and allowed to go to roost in this condition. All these are causes of lowered vitality, producing susceptibility to disease. The remedy is obvious.

Another very frequent cause of disease is the too common practice of breeding from a fowl which has been cured of disease, and so perpetuating the disease fifty, perhaps a hundred fold, for every chick hatched and reared from such a bird is liable at any time of its life, if its vitality is lowered, to develop the same disease. How often do we see a poultry keeper wasting time and money treating a sick bird, and attempting to cure it of an infectious disease. It is time and money wasted, and if the cure is effected, the bird no matter how valuable, is absolutely useless as a future breeder. If a female, its only future value is as a layer of eggs for eating; if a male, it is of no value whatever.

It does not take long to produce a flock of birds as hard as nails and practically disease-proof. This, it is observed, has already been done; and a case in point is mentioned, namely, that of a successful farmer in Rhodesia who adopted the practice, for the first two or three years, of destroying every adult bird or chicken which showed the slightest sign of disease, or even weakness. The treatment seems drastic, but it pays.

The article concludes with the following valuable hints to poultry keepers:—

How to prevent disease.—Keep the birds in good health and vitality, by giving them proper treatment, *i.e.*:—

- never overfeed;
- give good, plain food;
- never allow the birds to become fat; make them take plenty of scratching exercise;
- give plenty of green food;
- give as much thick separated milk as the birds will take;
- always have before them abundance of clean, cool fresh water;
- always see that they have abundance of grit and charcoal of a suitable size constantly before them;
- give them clean, well ventilated, but not draughty houses to live in;
- see that the houses are rain-proof, never damp, and admit the sun's rays into all parts;
- keep the birds free from insects by occasional dipping;
- also spray the houses occasionally and so keep them free from insects;

never waste time and money, in attempting to cure a sick bird, but kill it and burn the carcase;

never breed except from the healthiest, strongest, and most vigorous birds;

never under any circumstances breed from a bird that has been ill and been cured;

hatch well and rear the chicks well, and never allow them to have any set-backs;

exercise every care when buying fresh stock; examine it very carefully and dip every new bird; isolate it for a week and dip it again before putting it with your own stock.

If you follow these methods, you will very soon have a perfectly healthy and very profitable flock of fowls, and one on which you can be justly proud. Further, if every poultry keeper would do this—and it can be done both easily and quickly—we should in time practically stamp poultry diseases out.

TREATMENT OF HOVEN IN CATTLE.

Bloat, or hoven, is due to succulent foods eaten under certain conditions, which cause the formation of large quantities of gas in the rumen or paunch, and in consequence a swelling of the left flank. It is most often seen—

(*a*) when cattle are turned hungry on to such succulent green food as lucerne, clover, &c.;

(*b*) when cattle used to dry feed are suddenly changed on to green soft food;

(*c*) when travelling cattle are allowed access to large amounts of green food, such as variegated thistles or any very succulent pasture;

(*d*) when cattle gorge themselves on wet grasses or herbage;

(*e*) when cattle are fed on roots or potatoes under certain conditions. Some animals appear to be more subject to hoven than others.

Keeping the mouth open with a gag, or a piece of wood, until the beast has belched most of the gas by mouth will be useful in mild cases. The internal administration of 1 oz. of bicarbonate of soda, and 1 oz. of ginger, is sometimes useful and it may be repeated in a few hours if necessary. In a bad case the most effective treatment is the puncture of the paunch. This is done on the left side in the flank at a point equidistant from the last rib the edge of the loin bones and the angle of the haunch. The correct instrument for this purpose is trocar and cannula. The cannula is a tube through which passes a sharp pointed instrument—the trocar. The instrument is thrust into the rumen, and the trocar is withdrawn, leaving the cannula in place, and through this the gas escapes. In case of emergency a knife may be used in the same way, the gas escaping through the cut, but complications may set in and cause death if this is not done expertly. After the gas has escaped the animal might be given a dose of linseed oil ($1\frac{1}{2}$ pint) and turpentine (1 tablespoon). This mixture should be well shaken up while being given.

Every effort should be made to prevent the occurrence of hoven in stock. In feeding lucerne and clover, if the animals are not used to it, they should be put on it gradually until they become accustomed to it. If lucerne is fed in a wet state, or after heavy rain—when it is soft and juicy—it will almost always produce trouble; and cattle should therefore be kept off it until it is drier.—*New South Wales Agricultural Gazette.*

PREPARATION OF YAMS FOR THE TABLE.

Roasted yams.—Lay a yam before the grates of the stove or in the oven, turning it occasionally until cooked, scrape off the outer skin, cut into pieces or mash with butter; serve hot.

Baked yams.—Pare a yam, put it in the oven and bake until soft, take it out of the skin, mash with butter, put back into the skin, cut in pieces and serve hot.

Boiled yams.—Pare a yam, put it into boiling water, cook until tender; serve whole.

Yams chips.—Pare a yam and boil until tender, cut it in chips; fry in boiling lard and serve hot.

Yam rice.—Pare a yam and boil until tender; press through a colander on to a hot dish; shaking the colander lightly every few seconds, to cause the yam to fall off in short grains like rice; serve very hot.

Yam rissoles.—Pare, boil, and mash a yam with pepper and salt and if liked, a little minced parsley; shape into rissoles, cover with egg and bread crumbs, and fry until a light brown.

Yam border.—Pare, boil, and mash a fair shaped yam, about two pounds in weight, and add to it two tablespoonfuls of butter, half a cup of boiling milk, one tablespoonful of salt, the yolk of two eggs (well beaten) beat the mixture until very light; butter a border mould, pack the yam in it, and let it stand for eight minutes, beat the whites of the eggs to a froth, add salt, turn out the yam, cover with the whites and put in an oven to brown; take from oven and fill the centre with meat or flesh heated in a saucer.

Yam au choux.—Take one pound of boiled yam, one boiled cabbage, two tablespoonfuls of cream, one ounce of butter with salt and pepper to taste, rub the yam and cabbage through a wire sieve, mix together with butter, cream and seasoning; pile upon a dish, and serve with fried croutons of bread around. Serve very hot.

Porcupine yam.—Take two pounds of yam, boil and mash with one egg and salt to taste, shape and roll in beaten egg and vermicelli, fry; serve hot with parsley.

Yam fritters.—Pare and boil half a pound of yam until soft, beat lightly with a fork; beat the yolks of four and the white of three eggs, and two tablespoonfuls of cream, two tablespoonfuls of wine, one desertspoonful of lemon juice and half a teaspoonful of grated nutmeg; beat all together until extremely light, put plenty of lard into a frying pan and drop a table-spoonful of the butter at a time into it, and fry the fritters to a nice brown; serve with wine sauce (served separately) or only sprinkle powdered sugar over them.

Yam pudding.—Take half a pound of yam, two eggs, one lemon, two ounces of butter, two ounces of sugar; pare and boil the yam, and rub it through a sieve while hot; beat the butter and the yam together, and allow the whole to cool; break the eggs and separate the yolks from the whites; beat the yolks until light and add sugar, the juice of a lemon as well as the grated rind, and the yam. Whisk the whites to a stiff froth and stir lightly in before baking; put in a well buttered dish and bake in a brisk oven for twenty minutes.—*Straits Settlements Bulletin.*

REPORT ON SAMABULA ESTATE.

By M. J. Reidy, Government Veterinary Office.

In the company of Mr. McKeown, the Acting Superintendent of Agriculture and Mr. J. J. Barker, Suva, I visited the farm of the latter gentleman which is situated about three miles from Suva. This property embraces valuable agricultural and grazing areas and was originally owned by the late Mr. L. E. Brown, an early settler in Fiji, who spied out one of the prettiest spots in the vicinity of Suva, commanding as it does an uninterrupted view of Suva Harbour and Laucala Bay. Mr. Barker has wisely divided his estate into numerous paddocks mostly for grazing, (but a certain amount is under cultivation,) so that the stock generally are able to roam over rich pastures and thrive under the generous treatment of this skilful stockowner. This land is situated between Laucala Bay on the east, and Tamavua River, and the slaughter-yards adjoin and bound it on the west. To the north it is bounded by native land and on the south by the Township of Suva.

There is an area of 1,400 acres occupying a goodly portion of the narrow neck of land situated between Laucala Bay and Suva Harbour. It is the most centrally situated block of land in Fiji, and it can be used either for stock raising or dairy farming. Owing to its proximity to Suva it would suit the latter purpose admirably.

Streams.—The Samabula River flows throughout the greater portion of this land, and as well as this river there are several creeks and springs. This ensures for the various paddocks a permanent water supply. The river itself is navigable for launches and lighters. Its average width is about 20 yards and its depth from 4 to 6 feet. It forms a series of picturesque views as it wends its way towards the sea where it empties itself into Laucala Bay.

Contour.—The land is gently undulating with low ridges, with here and there very rich and fertile river flats, and all of the land is ploughable. There is sufficient timber growing on it to keep the fences in repair. The soil is of a chocolate colour and very rich and fertile.

Rainfall.—Average 130 inches.

Temperature.—70° to 84°.

Vegetation.—This equable temperature with copious rains and fertile soil has but one result that is to produce a wonderful growth of grasses which are maintained in an evergreen state throughout the year. Of course the rich river flats carry the best, and most excellent fodder, but even the hill tops carry a species of clover which is closely eaten down by stock.

Valuable experiments have been carried out by Mr. Barker. He has introduced several grasses and grown them with varying success; those giving the worst returns are eliminated whilst those giving medium and good returns are retained for further trials. Amongst the introduced grasses are Para grass, Paspalum, Mission, and Guinea grass. As a result of these trials Para grass has been found to be the best of any of the introduced or native grasses both as to quantity of fodder and ability to fatten stock in the least possible time. This is the well considered opinion of Mr. Barker and others capable of judging. Its powers as a fattener and finisher are indeed remarkable. On this occasion I saw cattle on this farm ready for the butcher which two months ago were in a very poor condition, they having come from a farm which was very much overstocked. It seemed incredible that they could have put on so much condition in such a short space of time.

Mr. Barker grazes his land in a scientific manner. Cattle are not allowed to roam all over it cutting up the ground and tramping in more grass than they can eat, but are enclosed in fair sized, well fenced paddocks. Immediately paddocks are over-done cattle are removed to new pastures and this allows the old ones to recover. I would advise anybody interested in stock to pay a visit to Mr. Barker's place. There a luxuriant crop of Para grass can be seen growing on poor soapstone soil covered only by a couple of inches of surface soil and situated right on top of a hill.

Carrying capacity.—At present only 600 head of cattle graze on this farm or one beast to 2½ acres, but of course this leaves fodder to spare. When all of the land is grassed up it will carry double the number of cattle.

Labour.—Consists of a mixture of Indians and Fijians who when not looking after stock are employed in growing yams, taro, kumalas, pineapples, bananas, maize, rice, tapioca, and paw-paw.

Fencing.—About 15 miles of 6-strand barb-wire fences enclose well arranged paddocks and a fence of 11-strands of wire 8 feet high surrounds a two acre paddock in which grazes a pure bred buffalo.

Cattle.—This farm is used as a breeding station as well as for fattening purposes. Zebu cattle or Zebu crossed with Shorthorn or other European breeds of cattle are mostly bred here. These animals of Zebu blood stand climatic conditions better than other breeds; they are easily fattened and are superior draught animals to any breed of European cattle. Here also may be seen a pure bred buffalo bull that has been mated with Zebu and European heifers. This is the first time the buffalo and zebu strains have been mixed; the resulting hybrid should scale heavy and should be valuable as a worker owing to its size, durability and hardy constitution.

Horses.—Fifteen horses all in very good condition mostly of the light draught type graze and work here. They go to show that horse breeding if necessary could be carried out with success on this farm.

Pigs.—There are well over 100 pigs (40 breeding sows), all looking healthy and in good condition. This branch of farming has only recently been tried, but so much success has already attended Mr. Barker's efforts in this direction that he is fully justified in carrying on this profitable industry on a big scale. The major portion of their food is grown on the place. A ready market and good prices are obtained on the island for pigs. A large number of these animals are imported annually although they can be raised at home with very little trouble and expense.

Roads.—The main motor road from Suva to Rewa and Nausori runs through the centre of the farm at a distance of some 200 to 300 yards from the dwelling house to which there is a very good private road, and on the western boundary of the farm runs the Colo-i-Suva Road.

Buildings.—The homestead is beautifully situated on the most elevated point very near to, if not actually, on the centre of the property. It is a modernly equipped one storey house. Other buildings consist of stable, byres, and styes of the breeding and fattening type.

General remarks.—Although there are numerous stock breeders in Fiji few or none of them carry it on as their chief business. It is a subsidiary industry for planters who run cattle on their plantations, because they play an important part in keeping down the grass thus helping the planter to keep down his labour bill, as well as being incidentally the means of swelling his banking account. Other breeders are natives and Indians who show very little judgment in this respect, most of their animals being of the mongrel

type. Supply is now greater than demand because the only available markets are the local butcheries, as well as a few shipments of fat cattle each month to Samoa and Tonga by Mr. Bayly of Nadi. Up to the present there has been no inducement or encouragement to produce more in a country eminently suited for raising stock.

Mr. Barker is the only land proprietor in Fiji who uses his estates to produce stock alone. His market is provided by his business of butcher and ships going to sea, but a time is near at hand when even his immense business will not be able to absorb the supply, therefore the erection of canning and freezing works will be necessary. The most convenient site for these is, in my opinion, near the slaughter yards at Tamavua. The river will take vessels of considerable draught, this site being adjacent to Mr. Barker's farm which can be used as a collecting as well as a fattening station.

Labour from Suva will be available so that it will be unnecessary to erect new houses for them; an important item now that building material is so expensive. If the plant only were erected at Tamavua, a storage shed might be built near the wharf, where supplies of meat could be stored.

Overseas steamers and inter-island boats could receive cargoes of tinned or frozen meat without further handling. For the purpose of building on the wharf a block of land could be rented from the Government.

As well as canning and freezing if Mr. Barker thought well of it he could also carry on the profitable business of manufacturing artificial manure from the bones and blood, &c.

In conjunction with the above a tannery could also be carried on as most of the tannin or tannic acid could be obtained from plants growing on the island.

As thousands of pounds worth of tinned meat is imported annually into the Colony the first proposition would be to supply the home market and the other islands of the Pacific Group. To my mind the main advantage of Fiji lies in the cheapness of the labour employed; both inside and outside the factory. This would put the producer in the enviable position of being able to undersell the opposition in almost any market.

I do not know of any proposition in which capital could be more soundly invested. In conclusion Mr. Barker has my best wishes for the success of his enterprise.

GRASSES FOR FIJI.

By G. M. McKeown, Acting Superintendent of Agriculture.

Paspalum dilatatum.—This grass which is a native of South America was introduced into New South Wales in 1892, a few seeds having been inadvertently included in a packet received from the above source by Mr. E. Seccombe of Wollongbar, in the Richmond River district. The distribution of this grass a year later was very limited as outside the farm of the producer no one had a sufficient area to prove its value as a pasture grass.

On the inception of the State Experiment Farm by the writer the first paddock for stock was laid down in paspalum and soon after it formed an important feature in the large number of trial grass plots which were established.

Considerable quantities of seed were produced and as the local value of the grass was rapidly established it was widely distributed to a very large number of applicants free of cost.

Queensland and Victoria received supplies from the State Farm and in a comparatively short time the grass was well established in the portions of the three States suited to its growth.

The progress of the dairy industry in the sub-tropical portion of New South Wales was greatly expedited by the wide distribution of this grass throughout the northern rivers of that State.

Extended tests proved that the grass would flourish in a wide range of climate and soils. The most luxuriant growth was made in the warmer parts of the State, but it was found to thrive well even at an altitude of about 3,000 feet above sea level. In other districts where the rainfall was light the pasture was less luxuriant, other grasses, clovers, &c., having a chance to grow, and thus the production of a mixed pasture was possible, which was of great benefit to the cattle grazing on it.

One of the marked features of the grass is the amount of protein disclosed by analyses made by the New South Wales Government Chemist soon after the introduction of the grass, the flesh forming content comparing very favourably with plants of the leguminous order.

Its chief fault under the conditions which are most favourable to it is its tendency to too luxuriant a growth when there are not enough stock to keep it in check.

This fault may be remedied in situations favourable to the use of machinery by running a mowing machine over it, or by ploughing it out when the surface growth has become matted, and resowing the paddock with it or other grasses. If grown in small paddocks it can be kept in check by heavily stocking before the growth is too far advanced. In parts of Australia it is extensively used for hay or ensilage, thus making profitable use of the surplus growth.

In suitable soils and conditions its capacity is one head of adult horses or cattle to the acre. In certain seasons its capacity is much above the average as three cattle to the acre have been well carried.

The best means of propagation is by seed, but it should be noted that only about 20 per cent. of the contents of the seed head is fertile the remainder consisting of empty glumes which look like seed. When collecting seed therefore only that which can be easily shaken from the heads should be used.

As the seed is covered with minute hairs it is liable to cling together thus rendering it difficult to sow.

This can be obviated and the seed placed in condition for easy distribution by mixing it with about five times its own bulk of well dried saw-dust or sand.

The seed will then separate readily. This suggestion will be of use in sowing all small seeds.

If paspalum seed be so treated five or six pounds of seed per acre can be evenly distributed by hand.

Favourable conditions for sowing will be found after any rubbish has been burnt on the land, while the ashes are dry, or in land which has been brought into smooth condition by ploughing and harrowing.

Seed may be sown on unbroken land which is fairly clean by broad-casting on the surface.

Para Grass (*Panicum muticum.*)—This grass which is the most valuable of those yet introduced into Fiji is so well known as to require no description. In most tropical and sub-tropical countries it is well known and its value so well established as to give it one of the most prominent places amongst grasses either for pasture or as a crop for soiling, *i.e.*, for cutting and feeding to stock.

No records of its yields of fodder in Fiji are available, but Hawaiian and other records credit it with 30 to 40 tons per acre. With judicious handling some of the smaller areas that I have met with here should yield crops equal to the higher figure. Naturally the highest yields will be obtained from areas which are started properly in prepared land and as the growth progresses the grass is regularly cut and fed to stock.

When used as pasturage the most profitable method will be found the sub-division of the area into a number of paddocks each of which should be stocked and fed off in turn, no paddock being allowed to be too closely eaten off. This course will ensure a constant supply of fresh pasturage for stock where the area and the number of stock are in due proportion. The fault observed in a number of cases has been over-stocking and a lack of provision for grazing systematically.

As the seed production of this grass is limited, nature has compensated for this deficiency by making provision for its reproduction and distribution by means of its system of sending out stolons or runners which send out roots from their numerous joints.

In most of the countries in which it is grown the method of propagation is by planting portions of the runners in land which has been prepared or otherwise.

In New South Wales the most approved method is, after breaking the land by ploughing, to open furrows with the plough. The plants are placed three to four feet apart in the furrows and covered by ploughing, and in favourable conditions the plants make rapid growth covering the ground in a few weeks.

The best demonstrations in planting and utilising para that I have seen in Fiji are being made by Mr. J. J. Barker on his farm at Samabula. Several methods have been tested, viz.:—

1. Cutting into sections, broad-casting and covering by ploughing.
2. Distributing runners on cultivated land and cutting up and covering by running the disc-harrow over it.
3. Ploughing the land and then opening furrows and planting the sets at even distances and covering by ploughing up to them.

The area planted in flat moist land is about 60 acres which is divided into three paddocks, each of which is judiciously grazed in its turn, thus ensuring the development of the maximum carrying capacity of the grass in each paddock. As in other countries the method of ploughing the land and planting the crop in furrows has proved far the most successful, but the other two methods have given excellent results which show that careful planting will prove profitable.

Mr. Barker's demonstrations further show that even on the soapstone ridges the grass gives satisfactory results in ploughed land. The best method of using the hill crops will be by cutting and hand-feeding stock as where the soil is shallow the grass is more liable to be injured by grazing stock than is the case in the richer flat lands.

The durability of the hill grown crop has yet to be fully tested, but in all cases the ploughing of the land and the introduction of the grass has resulted in the suppression of objectional growths such as Koster's Curse, sensitive plant, &c., their places being filled by a useful fodder crop which shows a handsome profit on its cost of production. It should be noted in all pastures, whether natural or prepared, that the carrying capacity of the land is materially increased by sub-division into paddocks to be grazed in rotation.

MAIZE FOR EXPORT.

On the subject of the possibility of maize export from Fiji the Acting Superintendent of Agriculture has received the following letter from the Manager of Brown and Polson (Australia), Limited, Sydney.

"The writer's experience is that of locally-grown maize Hickory King gives the best results, but of the world's varieties the Rhodesian White stands in a class by itself.

"For both this and Hickory King I may say that there is quite a considerable demand for broad-casting for green fodder.

"This demand is usually met in Sydney, and seeing the duty (1s. per cental) at present in force on imported maize, I think the Dominion might offer a more profitable though certainly more limited market.

"In buying, we look for the driest maize of milling standard, and where the local white runs from 12 per cent. to 18 per cent. according to the time of year, imported South African maize never exceeds 11 per cent. to 12 per cent. of moisture.

"This would be one objection to maize from Fiji unless it was kiln-dried, which would only be a payable proposition if the grain were by this means hurried forward to meet the end of the season's shortage in January and early February.

"For horse feed or broad-casting the moisture content, except where so high as to develop mould in transit, does not, of course, matter.

"While on this subject I would like to emphasise the importance of grading for export.

"Grading in South Africa is a fact not fiction and the result is that the Union to-day is the most reliable export market in the world for maize. They grade as to colour, size, and moisture content."

SOIL DRAINAGE.

By Claud Bald, in *Tropical Agriculturist.*

This article is not written as a complete dissertation on the difficult and complicated problem of soil drainage but rather as a short note in which are mentioned some of the more important points in order to stimulate a greater interest in this, one of the most important of agricultural operations. Too little attention is often given to this problem, doubtless because it means a large expenditure of money. On the other hand it must be realised that until a soil is properly and efficiently drained it is impossible for it to be in the best condition for yielding maximum crop returns, and in fact it is often the controlling factor that retains the crop at its present low level. Before, however, it is possible to arrange a drainage scheme for a garden it is necessary to fully appreciate exactly what is required and expected. What is meant by drainage? Certainly not the mere cutting of drains at certain intervals in an area. The drainage of an area of soil implies the removal from the soil of excess water that is not required and the means employed to bring this about is the drainage system. Some few soils, owing to climate conditions, their geographical situation and their physical condition, &c., eliminate excess water naturally and without any artificial aid, but this is not so in the vast majority of cases. Natural drainage as a general rule is insufficient to meet the requirements in this direction of the tea plant, which is or should be deep rooting if it is to resist the varying extremes of climatic conditions that pertain to North East India.

Since drainage then is the removal of excess water from the soil, it is necessary to inquire what is excess water. Any naturally situated piece of soil consists of soil particles made up of small pieces of rock and mineral matter and organic matter, &c., patched together in a more or less loose manner, leaving in between the particles interstices which can be filled with fluid substances such as air or water. If such interstices are completely filled with water the soil is water-saturated. For agricultural purposes it is necessary that these interstices be filled with air and partly with water, the water being in the form of a film spread over the solid particles. Such water is held together as a film by capillary force and cannot be removed by drainage. The amount of water so held in a soil varies with the type and class of the soil. As the amount of water increases so the force retaining it entirely as a film becomes less until a point is reached where what may be termed free water is present, that is to say water that can be removed by drainage, and the object of drainage is to remove such water, for its presence in the soil means that it is occupying space between the soil particles that should be filled with air, and aeration of the soil is in consequence deficient. It will be noted that film water cannot be removed by drains and film water is able to supply the full need of a growing plant provided the root formation of the plant has suitably developed, which can only be when the soil is sufficiently aerated. A soil that at one time is unduly filled with water and at another time has no excess water will not permit of proper root growth, and plants in such soils often suffer severely from drought. There is with all soils a certain definite water content that renders the soil in its best physical condition. This point is readily recognised by expert gardeners from the feel and appearance of the soil and it is then in the best condition possible for producing maximum plant growth. The water content of the soil at this point is known as the optimum water content and it is as close to this point as possible that it is desirable to keep the water content of a soil. A soil in which the water content is below this point is unduly dry and above this point the soil contains too much water. The optimum water content of soils varies considerably according to their nature, but is lower with sandy soils than with clay. In the case of a peat bheel it is very much higher than with clays. As instances the following may be cited of tea soils:—

A sandy soil has an optimum water content of about 15 per cent.

A clay soil has an optimum water content of about 20 per cent.

It has already been explained that excess of water in a soil means a deficiency of aeration in the soil, but this is not the only ill effect arising from insufficient drainage. Excess water aids in the formation of pans in a soil, formed largely of iron and aluminum silicates, and this is easily noticed on many insufficiently drained tea soils. Excessive quantity of water in a soil increases soil acidity partly in a direct manner but also indirectly by bringing about lack of aeration and the prevention of oxidation and by modifying the development of the various forms of micro-organisms in the soil. It also causes certain plant food substances which in a well aerated soil would be in the soil solution to be removed from solution either by precipitation or absorption. Nitrogen, potassium and phosphorus can all thus be rendered non-available for the use of the plant. The non-availability of the plant food in a soil is a very general feature of many of the badly drained areas of tea. It may be noted that manures added to such soils usually exert but little influence on the tea. They are rendered non-available. The general effect then of non-drainage of a soil is to render the plants growing there unhealthy and much more liable to disease attack. To

mention but one or two of the pests and blights that are more commonly in evidence on such plants:—Red spider, Red rust, Root disease, Mosquito blight, and canker.

It is of course obvious to every one that a low-lying piece of land surrounded by higher land, where water stands after rain, is in need of drainage but it is not always so obvious to casual observation that level land or land gently sloping is in need of drainage, and still less obvious if the land is a steep slope, and the remark is often heard " such and such piece of land can't want drainage, it is naturally drained." This is in the majority of cases not correct and a further study at all times of the year of the water conditions in the soil will soon reveal the fact. Another class of soil that is often supposed by reason of its situation to be drained is a high plateau. In some cases the top soil on the plateau is of a good open texture but underneath at no great depth is a subsoil of a clayey nature and this may be saucer-shaped, deeper towards the centre of the plateau, and nearer the surface at the edges. The water is then held in and the whole drainage is towards the centre where the water accumulates. On plateau land the permanent water level is often very far below the surface even in the rains, but on account of the close texture of the subsoil the water that accumulates in the top soil cannot percolate sufficiently rapidly through the subsoil and in districts where rainfall is very heavy in a few months of the year as in the Duars, where 200 inches may be precipitated in about three months, the water accumulates in the surface soil to such an extent that the soil becomes almost saturated. Such soils can only deal successfully with a very evenly distributed rainfall without any precipitation. Badly drained soils owing to the bushes being shallow and heavy-rooted suffer more from drought than well drained soils and this is particularly noticeable in the case of heavy clay soils. Another feature of badly drained soils is that the early flushes of the tea bushes are good, but that later on, commencing for example with the third flush and continuing until September, the flushes are not as good and as heavy as they should be. This is due to the advent of the monsoon and the heavy rainfall leading to water-logged soil, drainage being insufficient to remove it rapidly enough.

Many times emphasis has been laid upon a form of cultivation that in clay soil districts having a heavy rainfall is often practised and that is light hoeing when the soil is thoroughly wet. It has been the writer's misfortune to see hoeing being done on a clay soil whilst heavy rain was actually falling and had been doing so for some hours during the monsoon period and when the soil would certainly be nearly saturated. It has been repeatedly pointed out that this puddles the soil and effectually prevents proper drainage and aeration. The reason for doing this that is often given is to find employment for the coolies, but it is surely possible to find a form of cultivation, *i.e.*, forking or hand weeding that shall not be doing damage to the soil; drainage also can generally be improved, and this work is easy during the rains.

A form of cultivation that is with great advantage employed on tea gardens is trenching and this does a very great amount of good in ameliorating soil conditions, but there are certain points to be noted in this connection. On sloping land if trenches are made on the contour they act as catch water drains and on heavy soils or soils not sufficiently well drained may and do cause the retention of water in the soil during the wet weather. On the other hand trenches cut at right angles to the drains and to within 6 inches of the drain sides greatly assist the removal of water. An effective and satisfactory manner of improving drainage on soils where the permanent water level is well below the surface is by growing deep rooting trees. What

particular kind of tree should be planted needs the careful attention of garden managers. For instance, on some gardens sau trees do well and the root system develops deeply, but in otner cases it develops almost entirely on the surface and the tea in consequence usually suffers, or gains but very little benefit. In another instance that came before the writer rain trees (*Pithecolobium saman*) were exerting a very beneficial influence on the tea by breaking up the subsoil and causing the tea to take deeper root, and by improving the soil drainage, yet this tree as a rule does not have any good effect upon tea. In areas in which drains are about to be made it is of essential importance in most places that correct levels be first obtained by means of surveying instruments. It is impossible on gently sloping or undulating iand to determine by the eye the most suitable direction for the drains. It is also of importance that when drains are made they should be at a proper distance apart. Drains cut too far apart are often seen, with the result that the area is not efficiently drained. On heavy soil drains need to be cut at 20 feet distance, beyond this distance they are too far apart. On lighter soils the distance can be increased, but drains cut further than 40 feet apart cannot usually do the work required of them. The depth of drains is also another matter of great importance and 3 feet appears to be the minimum depth of practical advantage. When first draining a water-logged section in which the roots are shallow it is not always desirable to cut the drains to the full depth at once. They should be made in the first year to a depth of 6 inches below the root depth and each succeeding year deepened until a minimum of 3 feet is obtained. If made to the full depth at once the *bushes* are liable to suffer until the roots have grown downwards. Another point that needs to be remembered is that drains once made do not efficiently perform their duties for ever. The movement of the soil water towards the drains carries with it the finer clay particles of the soils, and these gradually accumulate at the drain sides until the interstices of the soil become largely filled in by such smaller particles and the rate of movement of water through the soil close to the drain side becomes very much restricted. This happens more rapidly in soils containing large quantities of clay and is not so noticeable in soils where the finer particles of soil are absent. In such cases it is necessary to cut new drains in the adjacent line of tea and when the sides of the new drains in their turn become clogged another drain can again be cut in the original line.

RICE AND ITS BY-PRODUCTS.

By JOSE L. CAMUS, *Philippine Bureau of Agriculture.*

The principal by-products obtained from rice are rice meal (broken rice), rice polish or bran, hull, and straw. The first three are produced in the milling process.

Rice meal.—This by-product is sometimes called broken rice, or " binlid." When palay is milled, some of the kernel is broken into small pieces which pass through the screen used in the mill. The amount of this by-product produced depends upon the adjustment of the mill and the condition of the grain, as when the mill is not well adjusted a large amount of the grain comes out broken; also when palay heads are cut unripe or when not properly cured the kernel becomes chalky and breaks in pieces while milling. Over-drying will also cause breakage.

A large percentage of the embryo of the kernel is found mixed with this by-product hence it produces a very nutritious and palatable feed; but on account of its high content of fat it turns rancid in a short time. It

serves as an excellent feed for cattle and pigs and when clean is sometimes used for human food. Its food constituents can be seen in the table of analysis given on page 83.

Rice bran.—This is sometimes called rice bran "tiqui-tiqui" or "darak." It contains most of the protein and some ground kernel and hull. It also has a high percentage of fat which makes it turn rancid if kept too long. When rice is cleaned by pounding in a wooden mortar (primitive method) or when the mill is not properly adjusted, a large amount of bran is produced. It furnishes a very rich food which is liked by horses and cattle. It is also an excellent feed for young chickens and for hogs when mixed with ground corn, cooked cassava, sweet potatoes, and banana stalks chopped fine. Rice bran alone though, should not be fed in large quantities to cattle as it is liable to cause stomach trouble, nor should it be given as an exclusive diet to young pigs. Extract of tiqui-tiqui is now on sale in nearly all drug stores as a remedy for "beri-beri."

Rice hulls.—This is another by-procuct produced in the milling process. It is called "ipa" by the Tagalogs. Rice hulls are too fibrous and unpalatable, and contain too little digestible matter to have any value at all as a feed for animals. They are, however, nowadays mixed with rice polish to make a well balanced ration for livestock. The chemical analysis of rice hull is given in Table 6.

In the modern rice mills hulls are used as fuel hence in passing through a rice mill the attention will be invited by the large pile of hull ashes. These ashes contain about 0·82 per cent. of phosphoric acid, and 0·93 per cent. of potash. The low content of these elements makes ashes only a weak fertiliser and for this reason they are not used where labour is cheap, as it hardly pays the cost of spreading them over the fields. The best and most economical method of applying them to the fields is to strew them over the main irrigation canals and let them be carried away by the irrigation water.

Rice hulls, however, make an excellent mulch for gardens and fruit trees. It is advisable to spread them on the rice paddies as they produce humus, which improves both the physical and chemical conditions of the soil. When burned the nitrogenous matter is lost.

Rice straw.—The dried stalks of rice are known as rice straw. This is a good forage especially when cut rather green and properly cured, and therefore worth preserving. Rice straw has been a total waste until lately. Now it is sold either loose or in bales. Its high percentage of protein and carbohydrates, as given in the table on page 83, compared with other straw, makes it an excellent feed for animals. As a fodder for stock its value is equal to that of other forage crops. No doubt in the future it will be utilised for other purposes as it can be woven to make rice sacks and mats or made into cellulose or paper, as is done in Japan and other countries. It will be just as valuable as imported baled straw, if cut green, properly cured, and baled. At present some of the straw is fed to cattle and the greater part remains in the fields and is either plowed under or burned.

The planter that burns his straw and hulls loses 63·92 per cent. of the total food material contained therein, while if he plows them under this loss is only very little.

The value of rice as a food.—Rice is a carbonaceous food containing as high as 77·55 per cent. of carbohydrates. Polished rice contains about 6·55 per cent. of protein and unpolished rice contains about 9·88 per cent. Rice is however deficient in fat and its protein content is very much

less than that of other cereals; so its deficiency in nutritive value should be made up with fish, beans, and meat, &c., which contain the necessary protein and fat. It is therefore by itself not so well balanced a ration as corn or wheat, which contain as high as 10·4 per cent. and 12·4 per cent. of protein, respectively; but in spite of the low percentage of protein that rice contains it has two advantages over other cereals—it is easier to prepare and to digest.

Inside the grain is a thin coating containing some phosphoric acid anhydride, which is essential to the human body. This coating is taken away when rice is polished. For this reason the unpolished rice furnishes a healthier food than the polished as the latter has lost its phosphorus content during the milling process. Too much polished rice causes a disease known as "beri-beri," unless it is supplemental with some foods containing the lacking element. For this reason poor people who cannot afford to eat much fish, meat, or other foods containing phosphorus are generally affected by this disease.

The following table shows the comparative food value of some cereals:—

Cereals.	*Water.*	*Ash.*	*Crude protein.*	*Fibre.*	*Nitrogen free extract.*	*Fat.*
Rough rice (palay)	9·6	4·9	7·6	9·3	66·7	1·9
Flint corn	12·2	1·5	10·4	1·5	69·4	5·0
Wheat	10·2	1·9	12·4	2·2	71·2	2·1
Rye	9·4	2·0	11·8	1·8	73·2	1·8
Barley	9·3	2·7	11·5	4·6	69·8	2·1
Oats	9·2	3·5	12·4	10·9	59·6	4·4
Sorghum	12·7	1·9	9·2	2·0	70·8	3·4

Its value as a feed for animals.—Palay and its by-products are among the best feeds for animals. Its analysis compares favourably with that of other cereals. The grain is fed to animals especially chickens and horses, in its raw stage, but it would be slightly better if it were ground. Broken rice or "binlid" when boiled is a good food for hogs, while the bran is for horses and young chicks. The following table of analysis will give the reader some idea of the relative values of the different by-products.

Table No. 6.

Cereals.	*Water.*	*Ash.*	*Fat.*	*Protein.*	*Crude fibre.*	*Carbohydrates.*
Rough rice (palay)*	10·89	9·45	2·58	7·44	9·28	64·30
Rice straw† ..	12·80	11·94	0·65	3·20	37·11	34·30
Rice straw* ..	10·84	14·04	0·59	3·31	32·91	38·31
Rice hulls* ..	8·97	18·29	0·49	3·50	41·89	26·96
Rice bran* ..	9·84	11·35	9·91	9·88	14·76	44·26
Tiqui-tiqui (rice bran).†	11·41	..	10·98	10·88	..	66·73
Binlid (broken rice).†	11·79	..	2·56	8·19	..	77·46
Unpolished rice* ..	..	..	..	9·88	..	69·67
Polished rice ..	..	..	..	6·56	..	77·55
Native corn ..	12·20	1·50	5·00	10·40	1·50	69·40

*Bulletins Louisiana Experiment Station. †Bureau of Science, Manila.

NOTES ON LEVUANA IRIDESCENS.
(*Beth Baker.*)

By H. W. Simmonds, F.E.S., Acting Government Entomologist.

History.—An endeavour has been made to trace the history of this moth in Fiji. The earliest definite record of it is made by Horne, who in 1877, remarked on the diseased condition of the trees in the Rewa district, and reports that the trouble was caused by a small moth, whose larvæ ate the undersides of the leaves.

In 1860, Seeman reports that the trees in the neighbourhood of Bau and Viwa looked as if boiling water had been poured over them. I was at first inclined to think that this referred to *Levuana,* but in another place he states, that the coconut does well on the smaller islands, and along the coasts of the larger islands, except at Bau and Viwa, and he then suggests the nature of the soil drainage as being the cause. I now think that so keen an observer as Seeman could not fail to have discovered the larva of *Levuana* had that been the cause, and that the real source of the trouble was the leaf mining beetle *Promecotheca reichii,* which gives just the scalded effect which he describes.

Williams, 1850–1860, *Fiji and the Fijians,* does not mention any disease as doing damage, but names certain varieties of coconuts as being cultivated.

It therefore seems to me probable that *Levuana* first appeared in Fiji between 1860 and 1877. During that period there was a considerable movement of labour and many Tokalaus, Solomon, New Hebrides, and Rotuma boys were brought to this country, and if *Levuana* should prove to be an imported species (and there is much evidence in that direction), I think there is considerable probabiilty that it was at that time brought in by such labour, and it is to those groups that we must look for its original home and natural enemies, and so ultimate control.

Outbreak in Suva in July, 1921.—During May, June, and July a few specimens of the moth were observed in town, but it was not until the middle of July that the source was located in the grounds of the Presbyterian Church, in Gordon Street. At that time only three trees were attacked, but on those trees the larvæ were in immense numbers. A neighbouring tree had numerous batches of eggs, and one or two larvæ, but several of these batches were observed to hatch and commence to feed and then disappear for some unknown cause. The subsequent history of this tree will be watched with interest.

Levuana on Oviri coconut trees from Tahiti.—A number of ova were placed upon young coconuts of the Oviri variety, which duly emerged and commenced to feed, after two or three days all had disappeared, but whether they found the food distasteful or whether they had been destroyed by jumping spiders a number of which were present remains to be proved and this cannot well be done until the trees are at least a year old. Half grown larvæ placed on one of these trees certainly fed for a few days freely.

Enemies of Levuana.—Two bugs *Tectocoris lineoli* and *Canthecona cyanocantha* were recorded by the late Superintendent of Agriculture, Mr. C. H. Knowles, 1906 and the late Government Entomologist, Mr. F. P. Jepson, 1916 respectively, as feeding upon this larva, whilst in 1918, Knowles observed a bird apparently also feeding upon this species.

To these I must now record the large metallic jumping spiders. Several of which were feeding upon the half-grown larvæ during this recent outbreak. One spider actually jumped on to a glass tube at a larva, a number of which

were being collected for experimental work. However, the enemies mentioned above are purely predatory and not parasitic, so that we must still hope to find the original home of the species, where it is sure to have many enemies both parasite and probably avian also.

Meanwhile the Government Bacteriologist, Dr. Carment, has been working on certain fungi obtained from dead pupæ from the last outbreak and others imported from Malaya, and his results are appended in a separate paper.

It is of interest that Dr. Carment shows that the fungus lies dormant in the hard body of the dead pupa or larva until warm moist conditions are provided when a vigorous growth of mycelium and spores is produced. This will account for the phenomena observed by Jepson, who noticed an almost complete disappearance of the pest in many localities about the end of April, and that they then re-appeared about August, *i.e.*, towards the end of the dry season; as it means that during the dry season few, if any, spores are produced by the fungus, and that the moth increases freely; with the rains fungoid growth recommences, and spores are produced, which after a time gradually overcome the increase of the moth and absolutely kill it out in many localities.

In addition to the authors mentioned above search was made in the works of Waterhouse, Hoare, and Jenkins none of whom remark on any disease, but the first and last authors state that the coconut does not do well above 600 feet.

We would be much interested if any one who knows of any early reference to coconut diseases in any old record, would communicate same to us.

FUNGOID DISEASE OF LEVUANA IRIDESCENS.

By Dr. A. G. Carment, Government Bacteriologist.

Larvæ of this insect were placed on strips of coconut leaf smeared with an emulsion of spores of a fungus, obtained by culture from dead larvæ and pupæ. The results obtained were not uniform, but this may be explained by the fact, that inoculation of the larvæ of the second batch was not done so thoroughly as that of the first and third experiment.

Experiment No. 1.—Larvæ were inoculated, besides smearing the strips of coconut leaf, and with the exception of one or two all died and on examination were found to be full of spores, and mycelium of the fungus with which they had been inoculated. From the diseased larvæ fresh cultivations of the fungus were made and with this and the Malaya fungus experiment No. 2 was carried out, but as stated above with unsatisfactory results. It is of interest to note that in both of these experiments inoculation with the spores of the Malaya fungus (said to be a verticillium) no disease occurred amongst the larvæ, while of those inoculated with the Fiji fungus which bred out many showed an unhealthy moist condition in the pupal cases.

Experiment No. 2.—Was only carried out with the culture of the Fiji fungus, and the caterpillars (larvæ) were thoroughly inoculated, with the result that in two days they showed sluggish movement and some had died on the third day (those that reached the pupal stage formed imperfect cocoons). When dead they were first soft, but soon got hard, being packed with the spores and mycelium of the fungus, and were converted into sclerotia, and on the ventral surface of the dead larvæ a fine downy growth of fungus was observed sprouting vertically. These larvæ, whether placed on culture medium, or only kept in a moist, atmosphere were rapidly covered with the plentiful growth of the fungus, the ærial hyphæ of which all reached an uniform height.

Along with the growth of the fungus in the larvæ were to be found raphides (needle shaped crystals of calcium oxalate), this being a common occurence with growing fungi. The ærial hyphæ growing from the body of the dead larvæ produced gonilia or spores, and these carried by the air infest living larvæ, but it is probable that their power of germinating may be limited to ten or fourteen days, so that they would require to reach their hosts within that period; this is the asexual cycle of the fungus.

There may be a sexual cycle also of this fungus by which the species is kept in existence, and in one stained specimen of a part of the mycelium of the fungus there was seen a structure not unlike an elongated ascus, containing ascospores.

The fungus belongs to the family of *Entomophthoreæ*, which are known to destroy insects and caterpillars. That there is a fungoid disease which attacks the larvæ of *Levuana* and is the main cause of the disappearance of the various outbreaks each year is highly probable.

Whether we can hasten destructive work remains to be seen, and in the meanwhile we have sprayed certain trees with an emulsion of the fungus, and it will be of interest to see whether this will start an epidemic amongst the larvæ under natural conditions.

Several tubes of the Malaya fungus were handed to me some months ago, but there appears to be in one culture tube a fungus different from that present in the others, and it being in the last tube from which sub-cultures were made, it is only now being tested, as to its larva destroying powers and no results have as yet been obtained.

GREEN CROP MANURING.

By Albert H. Benson, M.R.A.C., Director of Fruit Culture.

Under the heading of "Intensive Cultivation" I drew attention in the July number of this journal to the very important and frequently unrecognised fact—that the application of commercial fertilisers to the soil is of little value to the crop growing on such soil unless it (the soil) contains sufficient moisture to dissolve the various available plant foods present in such fertilisers and thus enable the plants which constitute the crop to absorb by means of their roots the plant foods which are essential to their proper development. It was further pointed out that the capacity of a soil to retain moisture during dry periods depends to a very large extent on the amount of humus or vegetable matter it contains, and systematic green-crop manuring was recommended for soils that are deficient in this constituent.

In the present number it is, therefore deemed advisable to follow up my remarks which appeared last month with a more detailed account of green-crop manuring, and the benefits to be derived from it as it is a matter that few fruit and vegetable growers not to mention agriculturists generally, realise the value and importance of.

The fact that many Queensland soils, especially those that have been under cultivation for some years are deficient in humus is shown by the large number of soil analyses that have been made by the Agricultural Chemist in which the organic matter of humus is low and in which the power to absorb and retain moisture is also low. Such soils are also usually low in nitrogen, and their capacity for nitrification is poor. This means that no matter how rich a soil is in other plant foods, such as phosphoric acid, potash, or lime, if it is deficient in nitrogen and does not possess the power to retain moisture, owing to a lack of humus, it cannot produce a maximum yield of either fruit, vegetable, or farm crops of any kind. Such a soil

cannot make good use of any commercial fertilisers, except in seasons of good and regular rainfall, and even then if the nitrogen contained in such fertilisers is in the form of organic nitrogen or ammonia it cannot be made use by the plant or tree until such time as it has undergone the process of nitrification and been converted into nitric acid in which form it is readily assimilated. The absence of humus as already stated, retards nitrification, hence a soil such as described can never be made to yield a maximum return until its deficiency in humus has been made good and its power to absorb and retain moisture has been increased.

Virgin soils, both scrub and good forest contain as a rule a fair supply of humus and this in conjunction with their undepleted supply of plant foods, frequently enables them to produce good crops for a few years even when given very indifferent attention and this is due not only to their supply of available plant food, but to the fact that their friable nature and power to absorb, and retain moisture is the result of their having a good supply of humus. As this becomes depleted the soil becomes firmer and more compact is less easy to work and dries out much quicker, so that its yield rapidly decreases and in extreme cases it is said to be worn out. This unsatisfactory condition of the soil is the result of bad farming; in other words "improper treatment" whereby it has been depleted of its supply of available plant foods and organic matter, and as no attempt has been made to make good these losses by judicious manuring and thorough cultivation, it has become unproductive.

It is absurd to say that any of our soils are already worn out, and therefore valueless as many soils that have become unproductive can be brought into a high state of fertility by proper manuring and cultivation.

In the older countries of the world, soils that have been under cultivation for many centuries are still producing good crops; in fact in many instances the yield is steadily increasing as the result of good farming, which means the maintenance of the soil in a state of perfect tilth and high fertility; so that what has been done and is being done there can easily be done in Queensland and elsewhere if we will employ the same methods as they do.

In warm climates the supply of organic matter in the soil is apt to become more rapidly exhausted than in colder climates, so that there is a greater need to keep our soils supplied with it, either by the addition of farmyard or other bulky manures rich in organic matter or by the growing of crops suitable for green manuring. Soils rich in oxide of iron also become rapidly depleted in organic matter, and that is one of the reasons why much of our best scrub land of volcanic origin, though extremely fertile and friable at first soon becomes much more compact, less easy to work, and less able to withstand a dry spell. Such soils require to be given a regular supply of organic matter to maintain their fertility; in fact, all soils that tend to set hard and dry out soon, need treating in a similar manner.

Here again the question of soil and climate has to be taken into consideration, as crops that would be very suitable in the granite belt would not be a success in the coastal districts and *vice versa*. The various crops suitable for green manuring must, therefore, be considered according to their adaptability to the climatic conditions under which they are to be grown and this will necessitate a brief description of the various crops and the best methods of growing them.

In the first place the most suitable plants for green manuring are those belonging to the natural order *Leguminosæ*, which includes all the members of the pea and bean families. The suitability of these plants is due, first to the fact that many varieties are very strong growers, producing a large

quantity of leaves and stems, which when added to the soil, either by allowing them to rot on the surface or by ploughing them under materially increase its organic contents. Further, these plants have the power of obtaining nitrogen from the atmosphere and of storing it in their roots, leaves, and stems so that when these decay the soil is enriched by their nitrogen contents. This is a very important consideration, as nitrogen is the most expensive essential plant food contained in any fertiliser, and if the soil can be kept supplied in nitrogen by green-crop manuring, then the bill for artificial fertilisers will be considerably decreased. In the late nineties I wrote several articles for this journal descriptive of a number of leguminous plants suitable for green-crop manuring and including amongst others, the velvet bean, pigeon pea, narico beans of sorts (lablabs), Mauritius beans of sorts, small Mauritius beans (*Phaseolus*), cowpeas, and peas of many kinds. Fruitgrowers however did not then pay much attention to green-crop manuring, with the result that, with the exception of our sugar-growers, the growing of these plants has not been continued.

The velvet bean, small and large Mauritius, and all lablabs did well; the pigeon pea though the latter being of a more woody nature, takes longer to become incorporated with the soil. Of the cowpeas tested the black was the strongest grower, and therefore, most suitable for manure. All these legumes are suitable for coastal districts and in addition to them, such crops as broad-leafed Essex rape and white mustard, grown during the winter are of considerable value.

All the strong-growing legumes should be given plenty of room, such as 18 inches to 2 feet apart in the row, and from 4 to 6 feet apart between the rows. If the soil is in want of manure, they should be given a dressing of 1 cwt. of sulphate of potash and 4 cwt. of basic superphosphate, or finely ground island phosphate, rich in lime as this will tend to promote a good growth, and when the green-crop is turned under the manurial matter will still be in the soil ready to be made use of by the permanent crop.—*Queensland Agricultural Journal.*

EXTRACTS FROM REPORT.

By Inspector Forsyth.

The ports of call were Cicia, Mango, Kanacea, Bavatu, Lomaloma (on Vanuabalavu), Naitaba, Taviuni, Buca Bay, Rabi, and Savusavu. No where but at Savusavu was there opportunity for more than hurried observation, but from this and conversation with various planters and overseers I shall be able to arrange inspections to better advantage.

Scale (*Aspidiotus destructor*).—No trace of this was discovered anywhere. At Cicia trees were pointed out to me as scale infected which proved to be a common scale other than the destructor and by no means numerous.

Leaf miner.—More or less prevalent in all districts, but everywhere heavily parasitised.

Stick insect.—This also is more or less common through Valeci and elsewhere it is particularly bad. Smoking is found very effective by most planters, but this simple remedy appears to be neglected on the plantations referred to.

Leaf moth (*Levuana iridescens*).—This moth was not observed anywhere and has apparently not made its appearance in these districts.

Spathe borer.—Appears to be very common and affects production to some extent. I understand investigations are being conducted by the department in regard to this and I would be glad of information in regard to it.

Bud-rot.—A few instances of bud-rot were encountered and the trees destroyed.

Fungoid disease (unidentified).—There was no opportunity to make systematic search for this disease, but where possible I described the disease and appearance of affected trees and azked planters to report anything resembling it on their estates, when an officer would be sent to investigate it. The area attacked at Vanualevu was inspected, 133 trees had been treated as recommended and judging from those treated a few months ago it is quite effective. The attack appears to be confined to an area of about five acres and possibly the careful work the manager is doing may prevent its spread. The trees at Sana thought to be affected proved to be suffering from a bleeding disease, apparently slow in action and easily detected was treated with tar, &c., as in the case of the fungoid disease. Four trees were observed, three treated and one left for further investigation. I found no traces on other plantations in the district of the fungoid disease, but I am awaiting reports from Inspector Macnamara, who was instructed to inspect through the various estates and is at present engaged on that work. Planters I saw personally are seized with the serious outlook if this disease spreads and will report suspicious trees I hope to the department. I photographed a tree under-going treatment. It is typical of many and shows the extent to which the tree has decayed. Beetles and larvæ were found in the decayed portion of the tree, but these are common and evidently only attack the tree when decay caused by the fungus has commenced. Larvæ of this beetle were handed me at Vuna and were probably taken from wood decayed from some other cause.

Koster's curse.—This has a hold in the northern parts of Taviuni and occasionally makes its appearance south where planters are offering labour a small sum for each root discovered. One or two planters complained that the natives did no work to eradicate it and for some reason Taviuni was excluded from the operation of the regulations regarding this weed. Small patches have been dealt with at Savusavu, and Mr. Macnamara's report should give an idea of its extent in that district. I am dealing with this subject separately.

Lantana.—This too has a hold in Taviuni and also in areas visited on Vanualevu. It is parasitised, but its eradication by this means does not appear likely. Some planters consider this should be declared a noxious weed.

Guava.—Also an appreciable pest in some districts and where neglected is costing much in labour and money to deal with it.

General observations.—Crops other than coconuts are not grown anywhere beyond labour requirements. I saw a small area of rubber evidently planted as an experiment perhaps ten years ago. Some trees show a fair growth but they are uneven and apparently neglected. I had no opportunity of inspecting stock except on Vanualevu. In this district only a few head were kept for labour and for that purpose no doubt they are satisfactory enough.

SCALE.

Vessels Trading between Infected and Uninfected Areas.

This is a question also which requires a certain amount of assistance from the Native Department in dealing with.

It is quite admitted that the scale can be transferred from one place to another on various plants and plant matter. That this has occurred is

proved by the presence of scale at Wakaya and Gau to windward of infected areas. Regulations are framed to combat this, but evasions occur and it is very difficult to trace and punish culprits. I have been able to secure convictions on several occasions, but I am quite certain that regular infringements are going on that we are unable under present circumstances to check. Even planters themselves proceed from infected areas to those uninfected, labour recruiting, and so forth, and the baskets and wrappings the Fijians invariably travel with and especially yaqona without doubt carry infection. To make the evasion of the regulations at least more difficult I think the Native Department could co-operate by calling for a return each month from the Buli or Vunivola of each district showing—

(1) the names of vessels that called at any town in the district;
(2) the town and district from which they came and their destination;
(3) the name of the captain.

These returns could be checked by the department with returns of vessels inspected at Suva, Levuka, and Lautoka and infringements detected. In places like Savusavu for instance and Lomaloma, where there are District Commissioners and the arrivals of cutters fairly frequent, it might be arranged for the police to furnish the return.

The knowledge that such a check was being kept on the shipping would act as a strong deterrant against this indiscriminate trading.

REPORT ON BUD-ROT IN TAVIUNI.

By H. W. Simmonds, F.E.S., Acting Government Entomologist.

In view of the reported occurrence in Taviuni of one of the diseases of coconuts known in the West Indies collectively as "Bud-rot," I was instructed to proceed to that island and investigate the outbreak and report on same.

I left Suva on 29th August, proceeding first to Cicia *via* Levuka. At Cicia I found dry conditions affecting the trees which in many places were also planted too closely together. The leaf miner (*Promecotheca reichei*) and the leaf eating moth (*Aganoxena argaula*) were bad on the portion of the island visited, and the nuts were small in most cases. There was a patch of very poor trees at the landing place. These trees probably did not have a chance as they were used to tether horses to and got much knocked about. My attention was called to one of these which was bleeding and was undoubtedly suffering from a trunk disease. The diseased wood was cut out and the natives were shown how to treat the wound. A number of the adjoining trees also had unhealthy scars on their trunks although not apparently at present actively diseased. Still I think the whole block which yielded very little would be better if cut out and replanted after a lapse of a year or so. Specimens of the wood from the bleeding disease were brought away for culture and examination. At one place a group of headless trees was observed and one with its head standing which seemed to be a possible case of bud-rot but there was no time to investigate this.

Mango was next visited, but it was too late when we landed to see much. The general yield along the beach seemed better than at Cicia which might be due to a heavier rainfall. From Mango we proceeded to Nabavatu where half a day was spent. In this island the mynah has not been introduced and there are no hornets. Native bird-life was abundant and the trees looked remarkably healthy. The only trouble at all apparent was the spathe borer which was undoubtedly doing damage, but whilst the leaf miner, leaf moth, and a fungoid spot on the outer leaves were present, they were scarce and did practically no harm. I would advise that every effort be made to keep this island free from mynahs which whilst they undoubtedly do some good are I consider far out-balanced on the other side by their harmful effect upon the very beautiful native birds, by their attacks on all classes of fruits and grains, and by the considerable toll which they levy upon the copra whilst it is drying.

TAVIUNI.

Taviuni was next visited. The yield of nuts along the coastal strips and for half a mile inland was here the heaviest I have seen in Fiji and quite equal to the best I observed in Tahiti. Half a mile or so inland was a portion where the yield was much lighter although the soil conditions seemed similar. The trees did not look so fresh and the spathes seemed to drop their flowers and frequently turn black. This portion is subject to a very heavy and continuous rainfall which I think is quite sufficient to account for the condition of the trees which had much the appearance of the mango flowers in Suva brought about by similar conditions.

DISEASES.

The leaf miner (*P. reichei*) and leaf moth (*A. argaula*) and the beetle *Calandra taitensis*) were present as in all places visited, but did little damage. The spathe borer was not nearly so much in evidence here as in some other parts of Fiji or, as Mr .Tarte informs me, it formerly was in Taviuni.

WORK OF AUSTRALIAN MAGPIES.

Mr. Tarte suggested that this might be the work of the introduced Australian magpie, although he had not observed them actually working in the crown of the trees, but had often observed them upon the leaves. Wet weather interfered much with my work, but I did observe one pair working amongst the spathes, but even if this bird has effected the improvement I think it would be more likely to be by working on the ground where the larva pupates than in the crown of the tree where it lives under perfect cover. The magpies I saw actually feeding were eating in each case observed, the red millipede.

BUD-ROT.

It was this disease which I was specially sent to investigate, and I was shown a number of trees most of which had been cut down and burnt. Three trees were shown me in which the central heart was gone and had fallen to the ground whilst the outer leaves remained on the tree and were apparently healthy, a certain number of also nuts remaining on in the tree. Roots were dug up and these seemed quite normal and healthy. These trees were scattered widely and surrounding trees seemed perfectly healthy. Three other trees were found in which the central heart had not yet dropped. Attention was first called to these by the last opening leaf failing to develope properly and dropping over. Sometimes this or the surrounding leaves have some or all of the leaflets crinkled in a concertina like way. Very often there was a small black patch at the base of the leaflet which tended to proceed down the stem to the heart and may in these cases mark the beginning of the attack.

On cutting these trees down at two feet from the ground the trunks were found to be perfectly normal whilst examination of the roots showed no disease. When the heart of the crown was examined it was found to be more or less diseased and rotten, the rot in one case having proceeded a couple of feet down the trunk where the central portion was in a soft spongy condition with a sour smell. The bud itself was rotten and filled with a pale-brownish slime, which had a most abominable smell. In some of the diseased trees borings, larvæ and pupæ of a beetle were found in the crown, but these were not present in the most typical case, where however fly maggots were observed. Cultures were obtained from each tree and handed to the Government Bacteriologist for examination.

In the West Indies three diseases have been found accompanying a rot of the bud. One a root fungus, another a leaf fungus, whilst the third is a purely bacterial disease. The one now under discussion in Fiji seems identical so far as symptoms are concerned with this one as also in the sporadic nature of its occurrence. All the trees attacked seemed between ten and fifteen years of age the older ones being almost immune. Whilst the disease was most prevalent in the very wet area I do not think that want of drainage causes the trouble as the light volcanic rock is exceedingly porous.

There seemed to be two types of the disease present, but that may be only apparent and not actual and simply depends upon what portion of the tree receives the first infection.

Specimens from all affected trees and from different parts were handed to Dr. Carment for bacteriological examination.

Dr. Carment tells me he has found bacteria present in each and suggests rats or flies as possible carriers. His full report is appended. It is of interest that in the West Indies "Bacterial Bud Rot" has been found to be a disease of wet districts often following a belt along the edges of the mountains ; a condition exactly reproduced in the area under discussion.

OTHER MATTERS OF INTEREST.

Mr. Tarte showed me an area where the trees all had a decided bend and falling off in the girth of trunk at the same distance from the crown, which had subsequently recovered. He informed me that this marked a time when buffalo grass took possession of this area and was marked by a corresponding reduction in the yield. Upon digging out the grass and putting in sensitive plant the trees and yield recovered.

Another experiment I saw was an area of about thirty trees all planted from one special tree. These were now about six years old and about one-fifth of them were showing phenomenal heads of nuts. The remainder were good trees, but so far as yield was concerned showed nothing special. We do not of course know the ancestry of the parent tree or from what source the pollen was obtained, but by the fact that one-fifth were true to type it comes near to the one-fourth of a typical mendelian cross. It would take three generations at least to isolate a pure stock, *i.e.*, twenty years, but the benefits of such a stock would be immense. These two subjects, *i.e.*, to test various leguminous cover crops to see if one could not be found which would have the soil improvement value of "sensitive" without its objections, and to try to breed out varieties of nuts which would come true to seed are well worthy of experimental effort and could be worked out if we had a commercial area to work on.

CONCLUSION.

There seems little doubt to me that we have in Fiji, and have had for some years, a disease akin to, if not identical with, the true West Indian bud-rot. The only treatment so far known is to cut out all affected trees and immediately burn or bury deeply with quicklime. Most of the growers are I believe alive to the importance of doing this, but at the same time it would be advisable to make it compulsory as it is little use one grower to cut his out if his neighbour continues to leave his to spread the disease.

In conclusion I would like to express my thanks to Mr. and Mrs Tarte of Taviuni and Mr. Allardyce of Nabavatu for much kindness and hospitality

MAIZE GROWING.

HINTS ON CULTIVATION.

1. Deep early ploughing and winter fallow should precede the maize crop.

2. Spring ploughing should not be deep and should be followed immediately by harrowing.

3. Disc harrowing before ploughing saves moisture and makes ploughing easier.

4. Rolling should always be followed by harrowing.

5. No amount of after cultivation can make up for insufficient preparation of the soil.

6. Maize should not be planted deeply in early spring.

7. Harrowing the young maize crop is an efficient means of saving moisture and killing young weeds.

8. Shallow cultivation is recommended for the growing crop.

9. Hilling is not advisable under all conditions.

10. The cultivation of maize should be continued, if possible, up to the tasselling stage.

HINTS ON SOIL IMPROVEMENT.

1. It is almost impossible to make the soil too rich for maize.

2. Legumes or grass pasture is the best crop to precede maize.

3. Farmyard or stable manure, if readily available, is the most valuable manure for the crop.

4. Green manuring with crops like velvet beans, cowpeas, vetches, and field peas increases the yield of the succeeding crop.

5. On the North Coast equal parts of superphosphate and bone-dust at the rate of 2 cwt. of the mixture has given an average increase of 8 bushels of maize at a cost of 15s.

6. On the South Coast a similar mixture at the rate of 2 cwt. per acre has given an average increase of 11 bushels per acre at a cost of 15s.

7. In the Tumut District 2 cwt. superphosphate per acre has given an average increase of 11 bushels of maize per acre at a cost of 10s.

8. On the Northern Tableland 56 lb of superphosphate per acre has given an average increase of 5 bushels of maize per acre at a cost of 3s.—*Agricultural Gazette of New South Wales.*

COCONUT BUD-ROT DISEASE (TAVIUNI).

By Dr. Carment, Government Bacteriologist.

The Government Entomologist left with me the following samples, which he had collected while investigating a disease of coconut trees at Taviuni:—(1) Sterile tube with part of diseased coconut bud; (2) three culture tubes inoculated direct from diseased plant tissue, and one culture tube with a piece from the extreme limit of the healthy plant tissue. Mr. Simmonds took every precaution to avoid possible contamination when obtaining the material, all his apparatus being thoroughly sterilised.

No. 1 contained a moist mass of diseased plant tissue in colour from yellow to pink and brown having a foetid odour like over ripe cheese. The sample

was originally white in colour, the change was probably due to fungi, which were seen on microscopic examination. Nutrient media were inoculated from this material and on these, bacilli and fungi grew which were identical with the direct cultures made by Mr. Simmonds. Further cultural experiments were carried out as there was little doubt that from the description of the diseased condition of the trees that they were suffering from true bud-rot, which is known to be caused by a bacillus of the coli communis group. Structurally and in culture the bacillus found was a species of the coli group, *e.g.*, it was motile, it did not form spores, it produced acid and gas in culture media and as a facultative anærobe is still further showed that it belonged to this family of organisms.

The disease of the coconut bud termed bud-rot is characterised by a putrefactive process primarily caused by a bacillus coli and the presence of moulds and yeasts is to be regarded as saprophytic and not disease producing otherwise bud-rot would be widespread. In considering the source of infection it must be remembered that bacillus coli communis is widely distributed, in nature being found in the intestinal canal of man, animal, and insect, and is a cause of putrefactive processes, and is spread by flies and other insects. The bacillus under consideration was inoculated on glucose peptone water, and tested for indol and the Voges and Preskauer reactions and found to be negative to the former and positive to the latter.

From the foregoing experiments we are able to say definitely that the bacillus coli found by us does not belong to the classical type of coli communis organisms, *i.e.*, it is not of human origin.

Mr. Simmonds also gave me some young coconut leaflets which were crinkled and shrivelled, owing to some disease process at their bases suggesting that it might be found to be due to a similar organism. Cultural experiments proved that the diseased conditions were entirely different.

Still another diseased condition of the coconut tree this time attacking the trunk was handed to me by Mr. Simmonds, from Cicia. A pure fungus growth was obtained from it on which a report will be furnished in due course.

GUINEA GRASS (*Panicum maximum*).

Guinea grass is perhaps more largely grown in tropical and semi-tropical countries, and in Jamaica, where it is known as Zacate, it is considered second only in importance to sugar as a primary product.

As its name implies, this grass is a native of Guinea, in Africa, and the *Kew Bulletin* supplies the following information:—" In Brazil this grass is known as ' Capim de Colonia.' It was accidentally introduced into Jamaica from the coast of Guinea as bird food about 1740. In 1794, Bryan Edwards wrote: ' Most of the grazing and breeding pens were originally created and are still supported by means of this invaluable herbage, and perhaps the settlement of the North side is wholly owing to the introduction of this excellent grass. Although it usually seeds freely it is generally propagated by root cuttings. When it grows rank and tall it should be cut frequently to prevent it becoming too hard and coarse. Analysis shows it to be very rich in nutritive qualities and where this grass can be fully established it is probably the best stall fodder, but is sometimes necessary to guard against over feeding with this grass alone in a rank state. It would form an excellent material for preserving in silos.' "

Unlike Para grass, Guinea grass is tufted, growing to a height of 3 to 6 feet. Some of the tufts when fully established measure 3 to 5 feet across. The

leaves are broad and flat, and the leaf sheaths and nodes of the stem are hairy. The inflorescence is generally well developed, although the seed does not set too well, and it also sheds very irregularly. The best results with this grass have been obtained in India, Ceylon, Fiji, Hawaii, West Indies, and South America. When planted in India it yielded in the first year 4 tons of green fodder per acre, and in the succeeding five years 28 to 100 tons per acre. In Hawaii it grows to a height of 6 to 10 feet, and is used principally as a soiling crop. If to be fed to horses without being run through a feed cutter, the crop should be cut frequently, as the grass becomes coarse at the base. It is not recommended in that country as a pasture grass, though 16 acres of Guinea and 4 acres of Para grass carried forty head of mules and horses for the year.

In British Guiana, the grass gave for five cuts during the year, a total of 107 tons of green fodder per acre.

Frequent references have been made to the capacity of this grass, for retaining its vitality for long periods. Plots twenty years old have been recorded, showing no deterioration whatever. One writer in India states: "There is no other plant, wild or cultivated, that yields such a large amount of greenstuff every year for a generation."

Guinea grass was introduced into the Philippines in 1907 and proved a great success right from the start. It is credited there with being the best perennial grass that can be cut for green feed, and its feeding value was highly spoken of. At one farm it was cut eleven times in a year, and averaged 110 tons of green feed for the period. The grass was fed to the work and saddle horses in place of hay, and an inspection of the animals showed their condition to be excellent. At the request of the American military commander, General Pershing, the military horses were fed with this grass, and it was found that 126 tons were required to feed 615 horses for a month.

Roots of this grass were distributed in 1898 from Wollongbar Experiment Farm to farmers on the Northern Rivers, who reported very favourably on it, and reference were made to its drought-resistant qualities and also to its adaptability for chaff and for ensilage. This was over twenty years ago and yet the fact remains that the grass has not become popular to any extent due probably to the advantages and the vigorous properties of paspalum and to the fact that Guinea grass is not a good seeder. The plots at Grafton and Wollongbar Experiment Farms have been established for a considerable number of years, and they are now as good as when first laid down. Yields of 40 tons of green feed per acre have been obtained from the plot at Wollongbar, and the one at Grafton does nearly as well. The grass sets a fair amount of seed, but it ripens unevenly and shatters easily, consequently the harvesting of the seed necessitates several operations during the year—a very bad feature in a grass. However, root planting is easily carried out, and a pasture has just been laid down by this method at Wollongbar to determine the value of the grass under grazing conditions. When established Guinea grass is just as aggressive as Para grass, and cannot be encroached upon by paspalum.—*New South Wales Agricultural Gazette.*

METEOROLOGICAL OBSERVATIONS.

Date.	July.			August.			September.		
	Temperature.		Rain.	Temperature.		Rain.	Temperature.		Rain.
	Max.	Min.		Max.	Min.		Max.	Min.	
1	78·6	62·4	·18	84·2	60·0	..	83·8	61·2	·46
2	78·2	6·06	..	83·6	61·4	·12	83·0	59·4	·40
3	80·2	64·0	..	82·4	59·8	..	82·6	59·0	·30
4	79·6	63·2	·10	83·6	62·2	..	84·2	63·2	·45
5	78·6	62·4	·20	84·8	62·6	..	83·6	61·4	·35
6	78·2	61·4	..	84·2	61·8	..	84·0	62·0	·10
7	78·4	60·6	·12	84·4	60·0	0·5	83·6	60·4	2·10
8	78·0	59·4	..	84·6	60·4	·08	84·2	64·2	2·70
9	77·6	59·8	..	84·0	59·8	·10	84·0	63·8	·35
10	80·4	60·2	·72	83·6	59·4	6·30	83·6	63·4	·36
11	79·6	59·4	·40	84·0	60·0	..	84·2	65·8	..
12	78·0	58·6	1·06	83·6	59·6	·14	84·0	65·2	..
13	79·2	58·8	..	82·8	59·8	·37	83·6	64·8	·10
14	78·4	58·2	..	84·4	60·0	·43	84·0	65·0	..
15	78·8	58·4	..	84·0	61·4	·20	83·8	64·6	..
16	79·4	60·0	·10	83·6	61·0	·03	84·4	65·0	·04
17	80·4	60·0	·03	83·4	60·6	·24	84·4	70·5	..
18	79·6	59·2	..	83·6	60·0	..	84·4	71·0	·07
19	79·4	60·2	·60	83·2	60·2	·04	83·6	70·4	..
20	78·6	60·4	·10	83·4	60·5	..	84·2	69·6	·70
21	79·0	61·4	·12	84·2	68·0	·76	84·8	68·2	..
22	79·2	60·4	·10	84·0	67·4	1·80	85·2	70·4	..
23	79·4	59·6	..	84·2	67·0	·20	85·0	69·2	·05
24	80·2	60·4	·01	84·0	64·8	..	84·6	68·4	·35
25	79·4	60·0	..	84·2	64·4	..	84·2	67·0	·22
26	80·4	61·0	·90	84·4	63·8	..	83·8	66·4	·12
27	84·2	62·6	..	84·0	63·2	·32	83·4	65·2	·15
28	83·8	61·4	..	84·2	63·4	·12	83·0	64·6	·08
29	84·2	62·8	..	84·0	63·2	..	83·2	64·4	·05
30	82·6	60·4	·06	83·6	63·4	..	83·4	63·6	·53
31	84·2	60·2	·05	84·0	63·2	..	..	..	..
	..	..	4·85	..	..	11·30	..	..	10·03

PRODUCE INSPECTOR'S REPORT.

Bananas exported.—To New Zealand: 1,403 bunches; 43,790 cases; equivalent to total bunches 88,983.

Other exports.—To Commonwealth: Coconuts, 2,014 sacks; Mauritius beans, 80 sacks; Tongan bark, 15 sacks; Pimento, 6 sacks. To New Zealand: Kumalas, 1,063 sacks; Coconuts, 179 sacks; Gum, 30 sacks. To Honolulu: Tongan bark and Pine, 10 sacks.

Plant matter.—To Australia: Total packages inspected, 49 (10 fumigated); from Australia: total packages inspected, 662; fumigated, 655; destroyed, 7 cases of Pears. To New Zealand: Total packages inspected, 84 (15 fumigated); from New Zealand: Nil.

Plant matter.—To Tonga and Samoa: 100 packages fumigated. From Tonga and Samoa, 65 packages fumigated.

Inspection of seeds and plants at Post Office.—Number of visits, 13; number of parcels inspected, 60; passed, 53; destroyed 7 as follows:—Four parcels rose cuttings, New Zealand, prohibited; 1 parcel beans, Hawaii, beetle borer; 2 parcels bulbs and cuttings for fungus; total, 7.

Vessels inspected to and from outlying islands.—Number inspected, 19; packages fumigated, 36; packages destroyed, 2.

Stock inspection.—Imported: sheep, 363; pigs, 110; cattle, 2 (1 bull and 1 heifer from New Zealand); horses, 9 (from New Zealand); dogs, 3 (from Australia); poultry, 127. Exported to Tonga: cattle, 120 bullocks; poultry, 1 crate (6 hens and 2 roosters). To Sydney: Cattle, 3 zebu bulls; game, 1 crate quail.

COUNCIL OF PLANTERS OF FIJI.

GENERAL MEETING, HELD THURSDAY, 25TH AND FRIDAY, 26TH AUGUST, 1921.

Immigration Advisory Committee.—Resolved unanimously on the motion of Mr. Barker seconded by Mr. Witherow, That Messrs, Hunt, Doyle, Duncan, and Powell be nominated to represent the Council on the Immigration Advisory Committee, and the Colonial Sugar Refining Company be requested to nominate the fifth member.

Circular Letter re Chinese Immigration.—Resolved unanimously, That the draft circular as read be forwarded to the elected Members and also the Colonial Sugar Refining Company, pointing out that steps be taken to introduce Chinese immigrants.

Commonwealth Embargo on Bananas.—Resolved unanimously on the motion of Mr. Witherow seconded by Mr. Powell, That the suggested reduction by the Senate of the imposition of 8s. 4d. per cental to 4s. 2d. per cental is insufficient as it would only permit shipment of Fiji bananas during October, November, and December, when prices rule highest, to enable shippers to reap any profit.

Exploiting Other Markets for Fiji Fruit.—Correspondence was read having reference to opening up a market for Fiji fruit in Canada, showing the favourableness of the prospects.

On resuming on Friday, 26th August, at 10 a.m., Lieut. White addressed members on his project for the establishment of an air service in the islands.

Bud-rot.—Resolved unanimously on the motion of Mr. Tarte seconded by Mr. Duncan, That the Government be requested to send the Entomologist to Taviuni to investigate and report on bud-rot without delay.

Fiji Labour Code.—It was explained that nothing definite could be done in regard to the Code till after the departure of the Viceroy's Committee.

Rev. Mr. Thompson attended and informed members of the position at present in India, he having recently returned thence.

The meeting then adjourned *sine die.*

AVERAGE RAINFALL (IN INCHES).

Station.	Total Rainfall for 1920.	Average Annual Rainfall to end of 1920.	No. of Years.	Average Monthly Rainfall. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Ba (Rarawai)	62·01	78·09	26	11·87	16·98	12·02	7·40	3·29	2·38	1·58	3·08	2·06	3·15	4·56	9·68
Ba (Navisa)	62·35	85·37	13	13·38	16·02	13·88	6·40	4·34	2·72	1·23	3·81	1·85	3·61	5·97	11·41
Ba (Namosau)	69·85	82·79	4	10·19	18·39	11·99	6·44	3·80	2·08	2·52	3·10	1·52	2·47	4·76	15·52
Baulailai	64·35	82·75	15	12·49	12·44	13·74	7·62	4·73	2·44	2·21	2·43	2·84	3·38	6·72	11·62
Buca Bay	98·08	99·13	8	8·54	12·78	13·45	10·34	7·55	6·06	3·41	4·53	4·28	5·63	7·79	14·77
Colo East	121·60	132·96	8	12·64	13·97	16·44	12·41	7·81	8·21	5·77	6·35	8·12	9·27	11·37	20·70
Labasa	76·06	79·52	26	12·63	14·39	13·28	8·01	4·10	2·25	1·95	1·80	2·71	3·31	5·06	10·01
Labasa	75·43	87·41	4	14·60	20·05	11·54	5·61	2·55	2·97	2·94	1·65	2·13	4·98	5·27	13·08
Lautoka	75·00	65·01	20	8·67	12·48	11·08	4·77	4·25	2·16	1·89	3·73	1·68	2·83	3·62	7·90
Levuka	95·58	89·76	25	9·03	9·96	12·37	9·62	6·87	4·47	3·69	5·76	5·03	5·51	7·93	8·90
Munia	53·70	69·70	25	7·72	7·89	8·64	7·69	5·20	4·58	2·74	3·78	3·45	5·24	5·86	6·90
Makogai	69·64	76·42	9	6·65	7·30	11·10	8·72	6·58	4·18	5·51	3·63	6·46	4·15	4·19	10·18
Nadroga	53·20	67·29	14	7·93	8·62	8·56	5·34	5·82	3·70	2·41	5·59	2·43	3·76	5·04	8·22
Nasinu (Expt. Station)	120·30	129·44	14	11·56	12·57	15·42	11·34	12·85	7·99	6·54	7·43	8·06	8·85	12·20	14·10
Navua (Naitonitoni)	111·01	125·00	4	8·99	8·92	10·61	16·00	13·24	10·37	8·53	7·98	8·95	8·97	9·76	12·66
Navua (Tamanua)	117·83	141·62	36	14·37	11·99	16·87	15·14	13·40	8·44	5·89	9·82	8·88	10·95	12 29	14·61
Rabi	108·25	154·25	16	18·68	16·97	19·25	16·68	14·78	7·38	4·68	7·35	8·49	9·84	11·30	18·82
Ra (Rakiraki)	75·63	81·77	36	11·73	14·84	12·34	9·60	5·45	2·65	1·88	3·17	2·30	3·35	5·42	9·43
Rewa (Nausori)	105·25	110·76	26	10·90	12·06	14·33	11·17	9·75	6·18	4·50	6·61	6·30	7·31	8·89	12·76
Rotuma	129·43	134·76	16	14·10	16·40	12·98	11·36	11·59	8·20	6·97	8·64	9·73	9·58	11·89	13·35
Suva	108·45	112·98	36	10·54	10·11	14·62	11·91	10·02	6·13	4·74	7·17	7·98	7·99	9·50	12·27
Taviuni (Salialevu)	274·85	214·46	8	13·82	14·09	16·30	19·78	18·24	17·53	14·16	13·01	29·27	22·84	13·81	20·77
Tavua	52·77	67·52	14	9·83	13·96	11·37	5·92	3·63	2·16	1·19	3·10	1·47	2·41	4·26	8·31

Agricultural Associations in Fiji.

THE COUNCIL OF PLANTERS OF FIJI.

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THE LABASA PLANTERS' ASSOCIATION.

THE SAVUSAVU PLANTERS' ASSOCIATION.

THE SOUTHERN DISTRICTS PLANTERS' ASSOCIATION.

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